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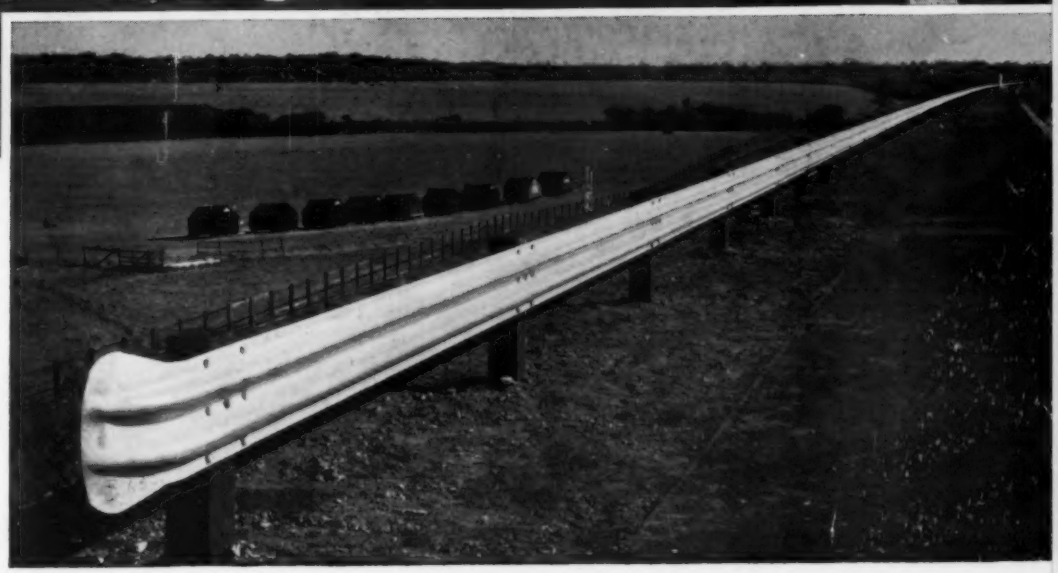

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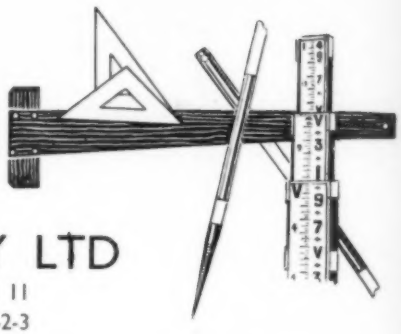

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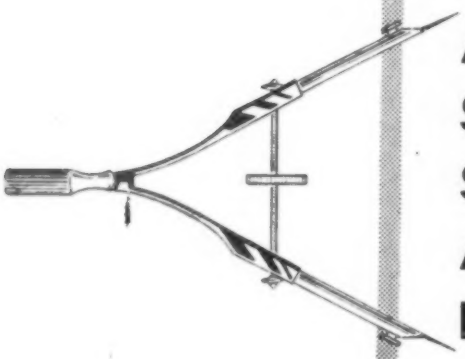

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TRAFFIC ENGINEERING & CONTROL

VOLUME 2 No. 8 DECEMBER 1960

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CONTENTS

Editorial Opinion 453
Topics of the Month 455

FEATURES

Prognosis for a Ring Road for Romford 456
Hugh Hurd

Accidents on the London-Birmingham Motorway 460
R. F. Newby

Motorway Sign Lettering 463
David Kindersley

American Report—Designing better Freeways 466
George Hill

Traffic Engineering Study Week—
Visual Aids to Driving 469
Granville Berry

Optical Guidance 471
Dr. eng. E.h. Hans Lorenz

DEVELOPMENTS ILLUSTRATED 472

Speed, Flow and Accidents 474
R. J. Smeed

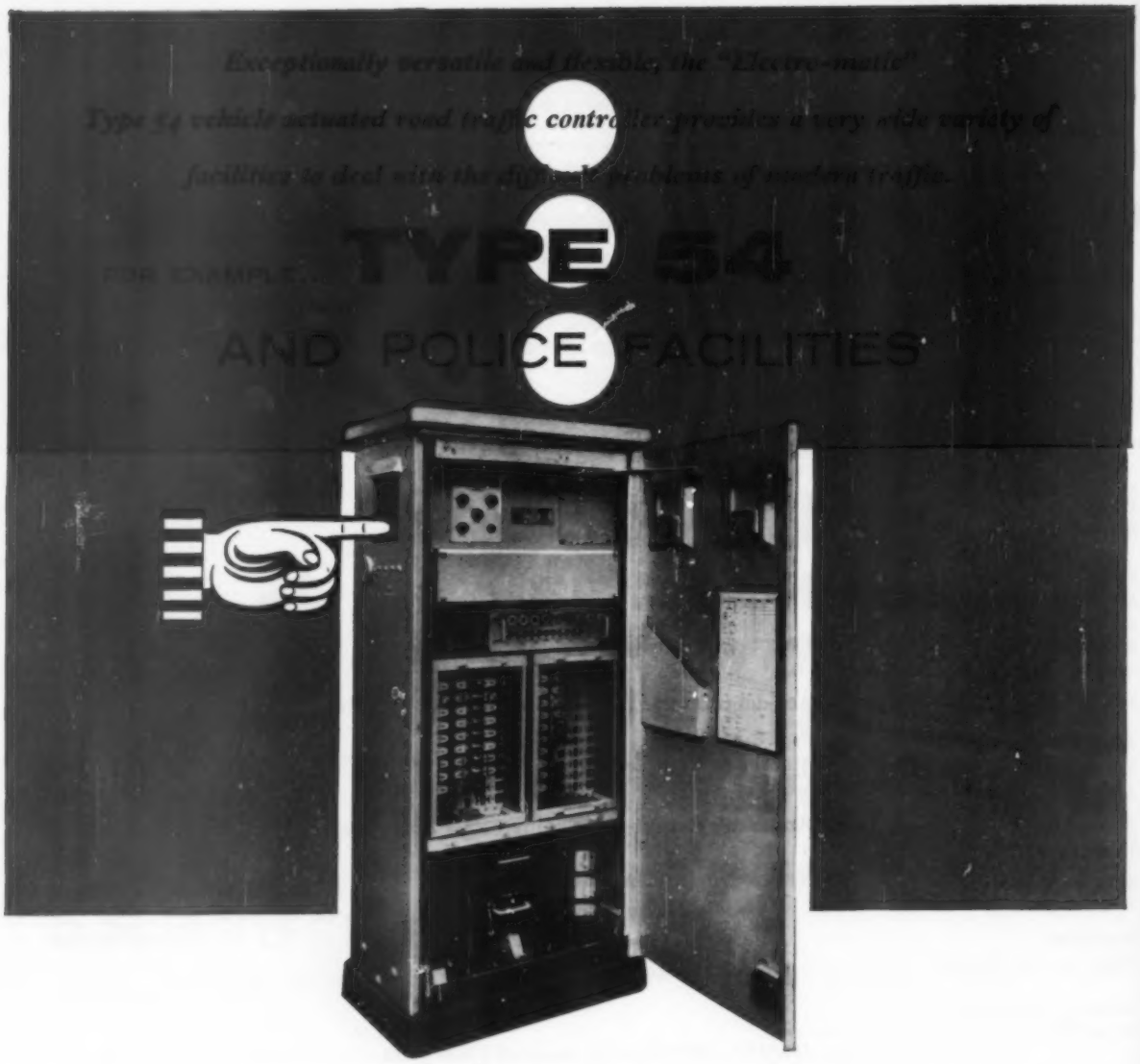
MONTHLY SECTIONS

Road Safety—International Road Safety Congress 479
Research—Crowthorne Track 483
Instruments for Traffic Engineers (4) Speed 484
F. D. Hobbs

Traffic Engineering Study Group—Dartford-Purfleet Tunnel . . 486
F. A. Rayfield

Parking—Chicago's Rush Hour Control 488
Letters to the Editor 490
Profile—Dr. George Charlesworth 491
Lighting—Middleton, Lancashire 493
J. T. Grundy & G. Mawson

Industrial News 497
Traffic Engineering Crossword No. 6 501



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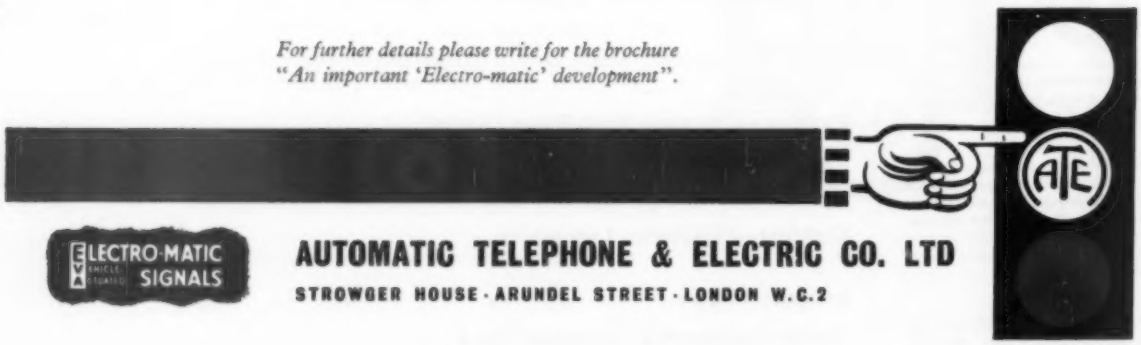

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Christmas Traffic

THE pre-Christmas period brings with it a traffic problem which accentuates the inadequacy of urban roads and traffic networks whenever increased demands are made upon them. To relieve this situation, the Minister of Transport last year instituted the 'Pink Zone', which in effect did little more than make more effective the then current parking restrictions, and to enforce them more stringently, and at the same time to provide a number of additional car parks mainly adjacent to the central shopping area. The result was not encouraging. Traffic flow and journey speeds within the zone were little changed, although delays were somewhat reduced. Within the adjacent zone the position deteriorated, with a considerable increase in delay. Since, however, it can be presumed that the volume of traffic increased considerably, there was, perhaps, some advantage gained, inasmuch as the position inside the zone was largely held. Presumably with last year's lessons in mind, the Minister has this year extended the area in which special provisions are instituted beyond the immediate central area and has introduced some new features. These are, in effect, no more than measures which should in any case be taken whenever and wherever congestion reveals itself, consisting as they do, in the main, of four provisions: first, the full enforcement of existing parking regulations; second, the provision of a greater number of off-street car parks; third, restrictions on loading and unloading at intersections, and fourth, the keeping of the main roads leading into the central area free for through traffic at peak periods.

It seems regrettable that only at times of peak demand are these obvious measures introduced in an attempt to ease traffic flow. With the establishment of a core of traffic wardens, backed by the ticket system, enforcement becomes far easier and there is no reason why it should not be fully effective, not only during the pre-Christmas shopping period, but at all times.

As to the provision of car parks, it is now four years since the report on the Parking Survey for Inner London found that control of parking in central London could not be effective without charging for parking on the streets and, at the same time, making ample provision for off-street parking. The two were seen to be interdependent, because, as long as it was possible to park free on the streets, off-street parking would neither be sought, nor could it be provided economically. At the same time, it was recommended that off-street parking should be provided in underground garages beneath the Royal Parks and London squares. But only now are parking meter schemes being extended to cover a large proportion of the central London area and Parliamentary powers being sought to construct a garage under Hyde Park.

Because of the failure to institute comprehensive parking meter schemes earlier, and to enforce the accompanying restrictions on the one hand, and to provide off-street parking on the other, it has become necessary to provide free temporary parks over the Christmas period, but it is difficult to understand why these parks can only be made available at this time. It certainly would be undesirable to detract from the amenities of the Royal Parks by turning them into open-air garages, but neither all of those provided are within them, nor do they encroach upon these open spaces. In particular, there seems no reason why the Horse Guards parade ground should not be permanently available and only closed when required for ceremonial purposes.

A convincing case can also be made for making permanent the Christmas period parking restrictions and the bans on loading and unloading, both at the approaches to intersections and on those roads leading into the central area. Since it is accepted that such measures relieve congestion, which is worst at peak periods, it would appear that any inconvenience caused would be more than compensated by improved traffic flow. On later pages an article shows how comprehensive are such peak period restrictions in Chicago, where they were introduced only after a full scientific investigation based on traffic engineering principles. Our failure to apply such traffic engineering techniques is one reason why it is only at times of emergency that adequate measures are taken to enable the traffic to get through more speedily. Lack of traffic data prevents the incontrovertible case being made out for such permanent measures being instituted.

While the 'Pink Zone' is limited to London, because the Minister has no similar power over other traffic authorities, what applies to the metropolis is equally applicable to major towns and cities throughout the country, where the problem of traffic congestion is no less and the means of tackling it no greater. Palliatives such as the 'Pink Zone' have to be resorted to during an emergency because adequate programmes for new road construction and improvement to meet traffic requirements, as revealed from data systematically collected and analysed and projected into the years ahead, have not yet been authorized in most urban areas. It is here that our roads programme is still gravely deficient.

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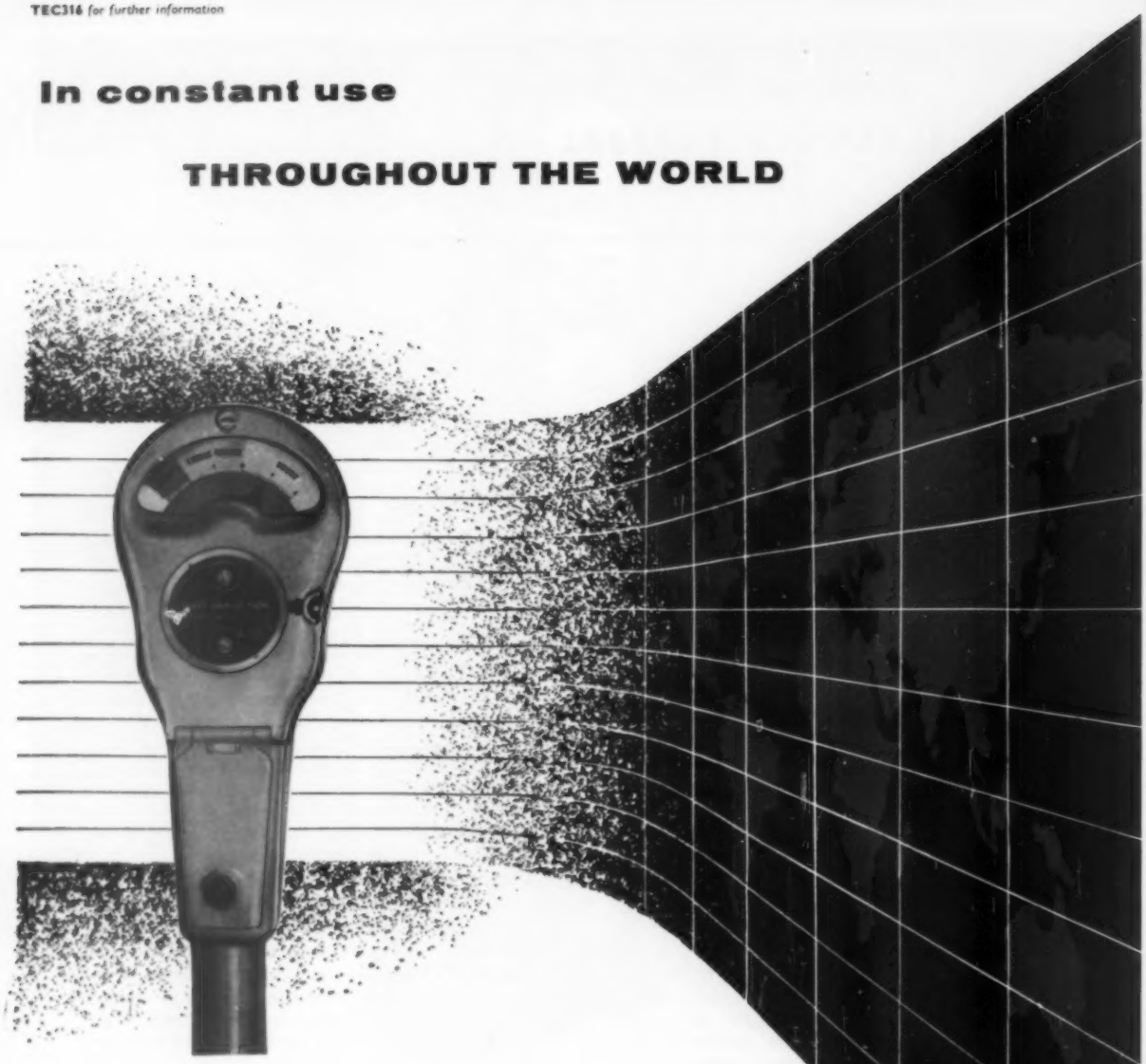

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Topics of the Month...

THE opening of the Ross Spur Motorway draws attention to the urgent need for an immediate revision by the Minister of Transport of all major road projects. This important link in road connections between the Midlands and South Wales has been constructed to standards which are certain to prove inadequate within the next few years. Its dual carriageways are only 24-feet wide and, while the Ministry claims that these are considered adequate to meet all M50's present and potential requirements, it is highly probable that a need for widening from two to three-lane carriageways will arise before the Sixties have run out. Because no such provision has been made the cost of meeting future demand, when it arises, will obviously be far greater than if the motorway had been constructed to full size at this stage. Unfortunately, the Ross Spur is not an isolated case. Of the 320 miles of motorways due for completion within the next five years, half provide for dual carriageways of two lanes only, with no ground acquired for future expansion. This is deplorable, and in the long run is certain to be proved false economy. For this short-sightedness there can be no justification, because it is now possible to predict within a reasonable margin the growth of traffic, as the survey which preceded the construction of the Birmingham Motorway demonstrated. Although traffic on M1 has not quite reached the volume predicted, it is not far off, and no one would suggest that the capacity of its three lane carriageways is excessive. The roads programme moves at so slow a pace that there is still time to revise the standards set for all projects not yet under way. Needs should be re-assessed and plans made to meet them with an ample margin. Failure to do so will mean that the optimum value will not be obtained from current expenditure and the final cost to the taxpayers will be inexcusably higher than would be the case if predictable needs were met now.

Road Safety

ROAD casualties continue to mount, having increased by nearly five per cent during the first nine months of 1960 compared with the corresponding period of 1959. Total casualties were 253,300, deaths accounting for 4,841, an increase of 482. Small comfort can be obtained from the fact that traffic expressed in terms of vehicle mileage is estimated by the Road Research Laboratory to have been eight per cent higher during the period, the more so since the casualties among drivers and passengers of four-wheeled vehicles were up by nine per cent, whereas traffic in this group increased by eight per cent only. It would appear, therefore, that the accident rate for the mass of vehicular traffic is rising. Another disturbing feature is the large number of pedestrian deaths, 1,771 for the nine months, an increase of 222. It is not surprising, therefore, that the Minister of Transport should express doubts as to the contribution that zebra crossings now make to road safety. This may be partly due to poor location of some and bad lighting of others, but it may also be that stricter discipline of pedestrians is now required. The Minister has, however, again rejected suggestions made in Parliament for a massive extension of control of pedestrians in connection with traffic signals which is so widely practised elsewhere. If special 'Walk' and 'Don't Walk' instructions were installed, where appropriate, with traffic signals, and their observance made mandatory and jay-walking prohibited there, then a considerable reduction in pedestrian casualties might result as has been the case since the institution of this system in New York. Provision for the stricter disciplining of pedestrians is foreshadowed for the new road safety legislation and it is to be hoped it will include some such provisions.

Work of a Traffic Engineer

AMONG the many interesting papers given to the Public Works Congress last month was that by Lancashire's traffic engineer, who described the work of a traffic engineering department in a county. This was illuminating, not only for the data produced on the scope of the work and the contribution it was making to the execution of Lancashire's road plan, improvement of existing roads and regulation of traffic, but also as to the position which he considered traffic engineering should hold in relation to the administrative structure of a local authority. In Lancashire, the Traffic Engineering Section comes within the County Surveyor's Department and largely grew out of the staff who prepared the Lancashire road plan, and who, because of the lack of central funds to carry it out, could be transferred to other duties within the County Surveyor's Department, where it still resides. For the present, this is generally accepted in this country as the best arrangement because, as Mr. Ogden pointed out, the traffic engineer's work is not extra work for the department but largely a re-orientation of responsibilities. As a result, he thought that, while the profession is primarily for a specialist, traffic engineering decisions are matters of the greatest importance in the work of a highway department and it is therefore essential that they be presented to the directing head with full force and lucidity. Since this cannot occur from a junior level, the traffic engineer must be a specialist and hold a senior post. He regretted that specialization normally implied a block in a career and suggested a way must be found to overcome this disadvantage. For this reason he thought the prospects for potential traffic engineers were somewhat obscure, which unfortunately must affect recruitment in this field. In such circumstances, staffs are likely to be made up of transfers from other branches of the civil engineering professions. This should not necessarily continue to be the case because with an increasing number of post-graduate courses for those with engineering degrees becoming available, and with the need for the specialists in this field increasing, and a shortage of such specialists persisting, traffic engineering posts, both with civil engineering firms and central and local authorities, should become available in greater number. It is proposed to publish extracts from Mr. Ogden's paper in this journal next month.

Romford's O. and D. Survey

Fig. 1. Tape recorder in use at Romford to record the registration numbers of all passing vehicles.

PROGNOSIS for a RING ROAD

by

Hugh Hurd, *A.M.I.C.E., M.I.Mun. E.,*
Borough Engineer and Surveyor, Romford

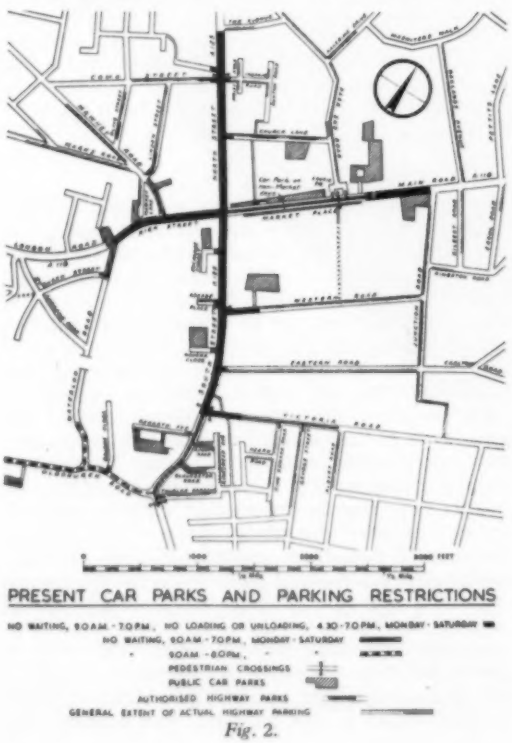
ROMFORD lies on the fringe of Metropolitan Essex, astride the old main highway (A118) from London to the Eastern Counties. The pattern of its town centre, with a long-established market still adjoining this highway, has remained virtually unchanged for centuries, but it now has to cater for shoppers who come from all parts of this densely populated corner of the county. In this role as a regional shopping centre the town naturally attracts a considerable number of vehicles and pedestrians, and by virtue of its location it is also subjected to a heavy volume of through traffic, much of which is morning and evening tidal flow to and from London and Thames-side.

To meet the growing threat of strangulation by traffic, the planners prepared, and the Borough Council and Essex County Council approved, a plan for a ring road round the central area of the town. This would intercept and divert all the converging traffic, and the main streets enclosed within it would ultimately become pedestrian ways. Only vehicles servicing shops or proceeding to car parks would be attracted into this inner core, and the line of the road was carefully sited having regard to these requirements, and to the utilization of existing streets.

While to anyone acquainted with Romford such a scheme appeared to be fully justified by the present volume of traffic, the Ministry of Transport required information as to traffic flows before they would give it their consideration.

An Origin and Destination survey to indicate the future use of the ring road was therefore necessary, and the figures obtained would also be of value in considering the detailed design at a later stage.

Even before such a survey could be undertaken, important development was already proceeding which would be affected by the ring road. Since the it might be regarded as prejudging the results, widening lines had to be prescribed, and for this purpose an overall width of 78 feet, allowing a four-lane carriageway, was assumed. It seemed unlikely that anything less would be required, and if the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PEDESTRIAN CROSSINGS
PUBLIC CAR PARKS
AUTHORISED HIGHWAY PARKS
GENERAL EXTENT OF ACTUAL HIGHWAY PARKING

Fig. 2.

survey showed this width to be inadequate, then an outer road system to cater for the through traffic element would have to be considered. In the event, the latter proved to be the case, and it is therefore suggested that the situation be met in the quinquennial review of the Development Plan on a regional traffic basis.

The Survey

In embarking on an O. & D. survey one is immediately faced with a number of imponderables and with the cumulative effect of human errors at various points in the chain of operations. With regard to the former, one can only make considered assumptions as to future trends, and as to the latter, it is felt that the system adopted in Romford reduced the effect of these to a minimum.

The exercise was to ascertain from present traffic movement the sections of the ring road likely to be traversed by vehicles making a known through journey, or originating or terminating in the town centre. The registration number system was chosen as the most suitable in the circumstances, and it was decided to record every vehicle rather than incur possible errors through sampling. By omitting scheduled buses, whose routes were known, and motor-cycles, which present obvious difficulties, it was found that only on four routes was the volume likely to exceed the ability of one man calling and another recording. In these instances electric tape recorders, plugged into near-by lamp columns, were employed and found to be very satisfactory. Due to the novelty of this method, E.A.P. (Tape Recorders) Ltd. of Romford, kindly loaned the necessary machines to the Council without charge.

It was decided to record the results and to undertake subsequent calculation in 'vehicles per hour'. Previous census figures were available, and with secondary counts the composition of the traffic, including the proportion to be added for motor-cycles, could be obtained, and thence the results translated into 'passenger car units', 'tonnage' or 'commercial vehicles per day', as required.

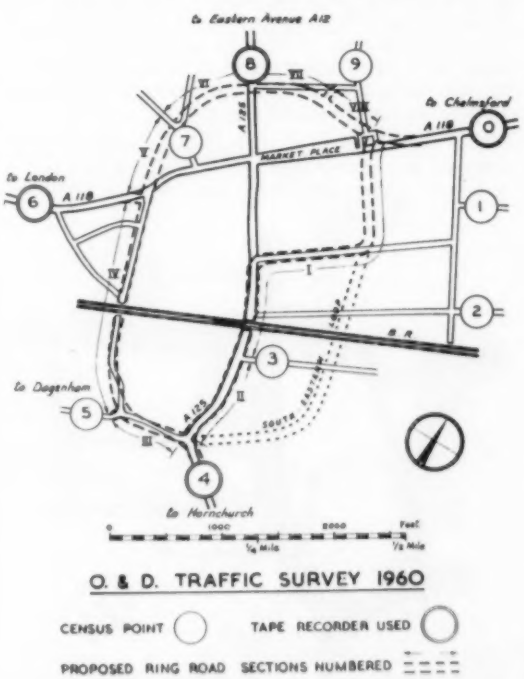


Fig. 3.

Fig. 4. Romford Market, showing its proximity to the main road, A118.

With regard to the duration of the survey, while arbitrary factors may link daily and hourly flows, it was considered that the capacity of the ring road would depend on its ability to cope with maximum conditions, particularly at junctions. In any event, to undertake such a survey over a long period would not only be costly, but add to the intricate task of analysing the results, and it was therefore decided to limit the operation to the morning and evening two-hour peak periods on a Wednesday (the midweek market day) so as to gauge the full effect of the London tidal flow, and to a further two-hour period at midday on Saturday when the traffic was heavy and its pattern complex. By adopting two-hour periods the number of enumerators was kept to a minimum, as no reliefs were required.

Dates and Census Points

The survey was fixed for Wednesday, May 25, 1960, 7.0-9.0 a.m., and 5.0-7.0 p.m., and for Saturday, May 28, 11.0 a.m.-1.0 p.m. Although the tape recorders were previously checked, unfortunately on the first ocassion one had been overlooked and gave trouble. Having learnt by this experience, the morning count had to be taken again on Wednesday, June 1, 7.30-9.30 a.m.

Ten census points were selected on radial routes near their proposed junctions with the ring road. On the seven major routes, two teams, each of two men, were stationed to deal with each direction of flow. On two routes, there was one team each, and on one minor route, one man only. Altogether, therefore, 33 enumerators were employed. All were volunteers and all but three were Town Hall staff. Payment was

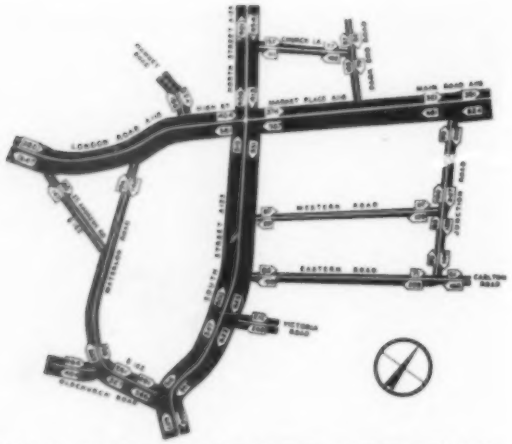


Fig. 5. Present traffic flow diagram—morning peak 8.00-9.00 a.m., Wednesday, September 9, 1959. The number of vehicles (including motor cycles but excluding pedal cycles) counted during the hour is indicated in each direction, and is represented by the thickness of the line. Figures in brackets have been calculated and are approximate only.

made at the rate of 5s. 0d. an hour on Wednesday and 7s. 6d. an hour on Saturday.

No obstruction was caused to traffic, except on one route only where it was necessary to channel vehicles by using barriers. The police were informed of the survey and were ready to give assistance if required, but, fortunately, everything went smoothly and, even more important, the weather was fine.

As a direct result of the survey, or of reading back the tape recordings, lists of registration numbers of vehicles entering and leaving at the census points were obtained. These lists were divided into five-minute intervals. At exit points the survey was extended five minutes at the end of each period to account for vehicles which had entered during that time.

Altogether, there were 720 five-minute lists thus prepared for inbound vehicles and 750 such lists for outbound vehicles. A total of about 34,000 numbers were recorded during the three survey periods, an average of 5,500 an hour.

Analysis

Through traffic was reckoned to comprise vehicles which left the central area within about fifteen minutes of entry, and an analysis, by the matching of numbers, was required to allocate these entering vehicles to one of the exit points. Those entering, but not leaving, within that period, were designated as terminating traffic, and those leaving, which had not entered within the previous fifteen minutes, were designated as originating traffic. It was found, in fact, that most of the through traffic cleared the central area within five minutes of entry.

As a trial this analysis was attempted manually. Nineteen volunteers in three teams were engaged on what amounted to games of 'housey-housey', one in a team calling out the registration number of each vehicle at an entry point and the others searching for it on the lists of outbound vehicles. As a result of this experiment it was found that the task would take 150 team-hours (excluding any subsequent check), would cost about £350, and would be liable to error. Furthermore, it seemed likely that the volunteers might dwindle in numbers, and in enthusiasm, as these rather tedious games progressed.

Enquiries were, therefore, made of firms who would undertake the analysis by mechanical computers and Madic Ltd. of Windsor were engaged for the purpose. The cost was much the same as the manual analysis, but time and manpower would be saved, and the results would be less liable to error. This company, by means of code numbers and punched cards, produced exactly the information which was required, and in the form of the following lists:

(i) The total number of vehicles entering at each census point during each half-hour period.

(ii) The total number of vehicles leaving at each census point during each half-hour period.

(iii) By matching registrations the total number of vehicles which left the central area
  (a) within about 15 minutes of entry,
  (b) between about 15-30 minutes of entry,
  (c) after about 30 minutes of entry, indicating points of entry and exit for each half-hour period.

(iv) Actual registrations collected under identical numbers indicating entry or exit points and five-minute period appropriate to each.

(v) Actual registrations of vehicles entering without leaving, or leaving without entering, excluding those listed under (iv). Listed in numerical order under each entry and exit point, with appropriate five-minute period indicated.

Prognosis

It was a matter of some urgency that the ring road scheme should be in the hands of the Ministry and only the half-hour of heaviest traffic in each of the three main periods was therefore selected for further analysis in the first instance, the results being doubled to produce hourly rate of flow.

Three senior members of the engineering staff were engaged in applying the existing traffic pattern to the projected ring road. Each dealt with a half-hour

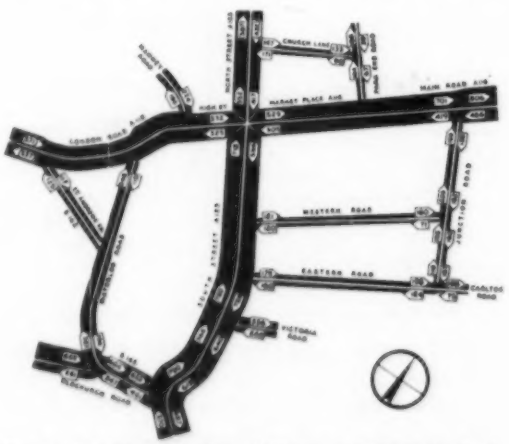


Fig. 6. Present traffic flow diagram—evening peak, 5.00-6.00 p.m., Wednesday, September 9, 1959.

period and passed his calculations to another for checking.

First of all, the list of identical numbers (iv) was examined, and further matching of vehicles leaving within 15 minutes of entry was made where an error in recording the registration letters was apparent. These were added to those already matched. This eliminated certain errors made by the enumerators and any others which still existed would only tend to increase the originating and terminating traffic at the expense of the through traffic, and have little effect on the total calculated flows on the ring road.

Preparing Flow Diagrams

A table was then prepared of through traffic against entry and exit points, and, by deduction, the terminating and originating traffic respectively at each. The ring road was divided into eight sections by the eight radial routes to be retained, and a second table drawn up showing the sections likely to be traversed either clockwise or anti-clockwise by drivers proceeding from any entry point to any exit point. Each section of the road was then weighted according to its anticipated attraction for terminating traffic in respect of car parks, service roads, etc., which would apply in reverse for originating traffic. On this basis, a third table was prepared showing a percentage of this traffic allocated to each section and for each direction. With the aid of these tables a calculation sheet was completed for each of the sections for both clockwise and anti-clockwise movement, totalling the three classes of traffic, and adding buses, from time-tables, and motor cycles, by proportion.

It was subsequently found that these figures were somewhat inflated by the addition of both originating and terminating traffic. In fact, these elements would

Fig. 7. Traffic flow diagram—morning peak—prognosis.

Fig. 8. Traffic flow diagram—evening peak—prognosis.

be largely complementary, those vehicles leaving car parks etc., taking the place of those entering. The totals were, therefore, finally adjusted to include only the greater of these two figures. It remained to convert these totals to vehicles per hour, and to multiply by a factor to convert present flow to ultimate flow. The results were then transferred to traffic flow diagrams indicating present flows and the effect of assuming such a factor to be 1.75 (i.e. 75 per cent increase).

The possibility of an additional loop to the ring road being under consideration, the effect of this on anticipated traffic flows was also indicated on the diagrams. This was obtained by splitting the figures already produced.

One Week's Work

While these operations may appear involved when briefly described on paper, they took the three engineers concerned only about a week to complete. No one would venture to claim absolute accuracy when endeavouring to predict the effect on traffic of a new road system, but it is felt that the results present a very reasoned and fair interpretation of the O. & D. survey. It is hoped that the Ministry will take a similar view.

A sum of £1,000 was originally allowed for the survey. Final costs have not yet been calculated but they are likely to fall well below this amount.

Acknowledgment: I would like to record my indebtedness to my Deputy, Mr. K. A. Walker, A.M.I.C.E., M.I.Mun.E., and to my Chief Assistant Engineer, Mr. D. G. Howard, B.Sc., A.M.I.C.E., A.M.I.Mun.E., for their part in devising and operating this traffic survey, and in the preparation of this article.

ACCIDENTS ON M1

by R. F. Newby, *B.Sc., F.S.S., Road Research Laboratory*

It is too early to assess fully the degree of safety of the London-Birmingham Motorway, which celebrated its first birthday last month, but details of accidents for the ten months November 1959 to August 1960 have been tabulated by the Road Research Laboratory and their findings have been made available for publication in this issue of TRAFFIC ENGINEERING & CONTROL.

ON November 2, 1959, the first section of the London-Yorkshire Motorway was opened to traffic. It consists of a length of the main motorway (M1), with a spur to Dunchurch (M45) at the northern end, and a spur to Park Street (M10) at the southern end. A further length of M1 between Waterdale Interchange and Aldenham Terminal, continuous from that already in use, was opened on December 21, 1959.

Approximate lengths of main carriageway are :

Opened on 2.11.59	60.4 miles of M1
	2.9 miles of M10
	7.8 miles of M45
Opened on 21.12.59	2.4 miles of M1
Total mileage	73.5

These lengths do not include slip roads or terminals. The general line of the road is shown in Fig. 1.

In the ten months since the road was opened the complete ranges of light and weather conditions, and of normal and holiday traffic, and various other factors, have not been experienced. For this and other reasons, it would be premature at this stage to attempt a detailed assessment of the road's safety potential. However, it is necessary for various purposes, and is also of much general interest, to know how many accidents have occurred so far, and under what conditions, and how serious they have been. The data in the following tables are sufficient to give an indication of this, but for the above reasons they are given without comment.

The accident rates in Table I, and the flows in Table III, are based on limited traffic data. As the investigation proceeds, slight revision of these values may become necessary.

Acknowledgments: The accident details have been extracted from information kindly supplied by the police authorities of the counties in which the motorway lies. The article is published by permission of the Director of Road Research.

TABLE I

Accidents and casualties, classified by degree of severity for light and dark hours, and rates of these per million vehicle miles: November 2, 1959 to August 31, 1960 inclusive

	Light hours		Dark hours		All hours	
	No.	Rate per million vehicle miles	No.	Rate per million vehicle miles	No.	Rate per million vehicle miles
Vehicle miles (10^6)	213.2	—	62.6	—	275.8	—
Accidents:						
Fatal	10	0.05	6	0.10	16	0.06
Serious	54	0.25	25	0.40	79	0.29
Slight	76	0.36	30	0.48	106	0.38
All injury	140	0.66	61	0.97	201	0.73
Damage only	137	0.64	78	1.25	219*	0.79
All accidents	277	1.30	139	2.22	420*	1.52
Casualties:						
Fatal	14	0.07	7	0.11	21	0.08
Serious	82	0.38	42	0.67	124	0.45
Slight	131	0.61	70	1.12	201	0.73
All casualties	227	1.06	119	1.90	346	1.25

*Includes four cases in which light conditions not known.

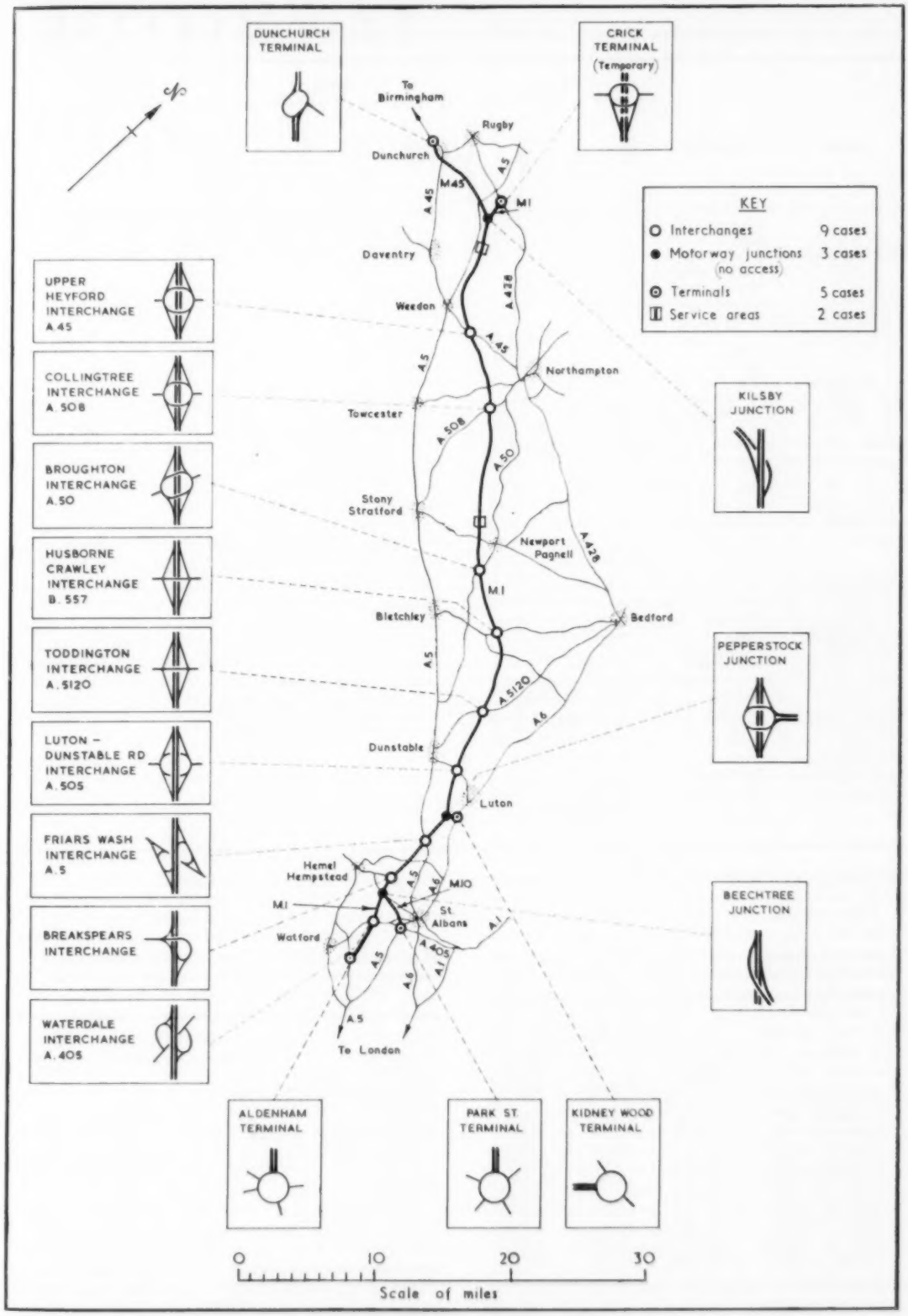


Fig. 1. London-Birmingham Motorway (M1).

TABLE II

*Accidents on the London-Birmingham Motorway under different conditions of visibility: November 2, 1959 to February 29, 1960**

Month	Visibility	Light				Dark				All hours			
		Fatal	Serious	Slight	Damage only	Fatal	Serious	Slight	Damage only	Fatal	Serious	Slight	Damage only
November 1959	Clear	1	3	4	5	—	1	2	9	1	4	6	14
	Mist	—	—	1	1	—	—	—	1	—	—	1	2
	Fog	—	—	4	2	1	1	1	3	1	1	5	5
	Falling snow	—	—	—	—	—	—	—	—	—	—	—	—
	Not known	—	—	—	—	—	—	—	—	—	—	—	—
	Total:	1	3	9	8	1	2	3	13	2	5	12	21
December 1959	Clear	2	3	5	14	—	2	4	9	2	5	9	23
	Mist	—	1	—	1	—	—	—	1	—	1	—	2
	Fog	—	1	7	4	—	—	—	2	—	1	7	6
	Falling snow	—	—	—	—	—	—	—	—	—	—	—	—
	Not known	—	—	—	—	—	—	—	—	—	—	—	—
	Total:	2	5	12	19	—	2	4	12	2	7	16	31
January 1960	Clear	1	2	5	15	1	2	4	6	2	4	9	21
	Mist	—	—	1	1	—	1	—	—	—	1	1	1
	Fog	—	—	1	—	—	—	1	—	—	—	2	—
	Falling snow	—	—	—	—	—	—	—	1	—	—	—	1
	Not known	—	—	—	—	—	—	—	—	—	—	—	—
	Total:	1	2	7	16	1	3	5	7	2	5	12	23
February 1960	Clear	1	1	4	15	1	2	3	14	2	3	7	29
	Mist	—	—	—	2	—	—	—	—	—	—	—	2
	Fog	—	2	2	3	—	—	—	—	—	2	2	3
	Falling snow	—	—	—	7	—	—	—	1	—	—	—	8
	Not known	—	—	—	—	—	—	—	—	—	—	—	—
	Total:	1	3	6	27	1	2	3	15	2	5	9	42
Total (4 months)	Clear	5	9	18	49	2	7	13	38	7	16	31	87
	Mist	—	1	2	5	—	1	—	2	—	2	2	7
	Fog	—	3	14	9	1	1	2	5	1	4	16	14
	Falling snow	—	—	—	7	—	—	—	2	—	—	—	9
	Not known	—	—	—	—	—	—	—	—	—	—	—	—
	Total:	5	13	34	70	3	9	15	47	8	22	49	117

*The number of accidents in fog, mist or snow between March, 1960 and August 31, 1960 was negligible.

TABLE III

Approximate mean daily traffic flow on the London-Birmingham Motorway; November 2, 1959 to August 31, 1960

Month	Vehicles per day (total both directions)		
	Friar's Wash	Newport Pagnell	Dunchurch
November 1959	14,500	11,600	7,000
December 1959	14,300	11,200	6,300
January 1960	14,100	10,600	6,000
February 1960	16,000	12,300	7,000
March 1960	17,500	13,600	7,300
April 1960	19,600	15,900	7,800
May 1960	19,900	15,800	8,200
June 1960	21,300	16,300	8,600
July 1960	21,600	16,900	8,900
August 1960	21,900	17,200	8,900

TABLE IV

Accidents and casualties on A5/A45 and M1/M10/M45 for the period November 1959 to August 1960 inclusive, and on A5/A45 for the corresponding months of 1958-59

	1958-59 A5/A45*	1959-60 A5/A45*	1959-60 M1/M10 M45†
Accidents			
Fatal	21	10	16
Injury (excluding fatal)	451	172	185
Damage only	516	168	219
Casualties			
Killed	28	13	21
Serious injury	245	102	124
Slight injury	464	147	201
Total casualties	737	262	346

*From Herts County Council Boundary to Dunchurch Terminal.

†From Park Street and Aldenham Terminals to Dunchurch and Crick Terminals.

MOTORWAY SIGN LETTERING

by DAVID KINDERSLEY

IN 1957 the Minister of Transport set up an Advisory Committee on traffic signs for motorways under the chairmanship of Sir Colin Anderson. It was recognized that the standard type of sign would not be suitable for the new dual carriageway roads, designed for speeds of 70 m.p.h., and without level intersections, and that a completely new type of sign was necessary. Twenty-seven interested organizations were consulted; existing practice for similar roads in the United States, Belgium, Holland and Western Germany was studied, the somewhat meagre research carried out both at home and abroad was examined, and practical experiments and demonstrations were arranged in conjunction with the Road Research Laboratory. From the recommendations of this committee the present motorway signs were developed.

Question of Size

Recently it has been suggested in *The Times* that as the M1 signs have been such a success, the same sort of sign should be used on all roads. I always knew that drivers once having experienced a sign that can be read at 70 m.p.h. would, in the absence of informed criticism, demand such signs on all roads. For the first time motorists can really read the direction signs. I hope to prove that this is purely the result of their size and not due to any particular skill in their design.

To turn now to technicalities, firstly, I should like to make it abundantly clear that I have no quarrel with the theory relating to the distance from which signs must be read, nor with that relating to the distance that signs must be placed in advance of turnings. Indeed, as a result of considerable experience and in accordance with present motorway practice, I support the conclusion that lower-case letters should have an 'x' height of 12 inches at least, if they are to be read at 600 feet ('x' height being the height measurement of letters excluding ascenders and descenders, i.e. the height of the bowl of b, p, d, q, etc.). My propositions accept all that these theories imply. My arguments are for better signs.

It is important to understand that some people have prejudiced the arguments against lower-case lettering by implying that lower-case is the only answer to the requirements of modern driving, particularly speed. Nothing could be less true. Much research in recent years and over the centuries has gone into the legibility of lettering, and a great deal has been learned. It is, however, my opinion that the new motorway signs ignore all the data collected except that relating to size, which is only one of the many points a designer must bear in mind, and is the easiest to determine. Attraction, spacing, inside shapes of letters, definition of letter-stroke termination and thickness are some of the points to remember. I will return to this later.

What is the reason for the adoption of lower-case letters? There is no doubt that a page of capitals is far less acceptable to the reader than a page of lower-case—particularly if the comparison is made between sans-serif capitals and serifed lower-case—sans-serif lower-case is very trying to the eyes of the reader. Traffic signs, however, are of quite a different order from a page in a book or newspaper and pose different problems. Lower-case achieves its greater legibility in a book since the reader is familiar with the word-patterns it forms, but it is my contention that place names are only occasionally familiar to the reader in the form of word patterns.

Advantage of Capitals

Capitals have a further advantage over lower-case in that they need considerably less space to achieve a like degree of legibility. This is something which can be more easily demonstrated than argued, but which means that smaller panels can be used, thus saving costs in erection and maintenance. Furthermore, although legibility from a distance is of primary importance on fast roads, signs should also be fully and easily visible from close quarters. The more compact they are, the easier this is. For night driving, too, it is important that the whole sign should be within the range of dipped headlights, for if it is not, it necessitates illumination, which in turn necessitates an elaborate concrete structure to carry the lights. The expense must be fantastic. Worse still is the destruction of the quality of the landscape, and it should be here remembered that the signs are often visible from places off the motorway (e.g. the gigantic sign near the M1 bridge where it crosses the A405 Hatfield-Watford road.) They are also the wrong shape. The choice of lower-case and the exceedingly inferior layout are the chief causes of their towering height. Wherever possible a horizontal stress is needed rather than a vertical one.

The argument of panel size would seem to be quite sufficient on its own. There is, however, quite a different point deserving consideration. There is a tradition in Britain, with sound logic behind it, of using capitals for the display of names:

TREASURE ISLAND,
an adventure story by
R. L. STEVENSON.

This distinctive use of capitals and lower-case assists swift comprehension and is particularly worth preserving on traffic signs:

over bridge to SOLWAY

In countries which have recently switched to roman from black-letter (in which displayed capitals are impracticable) conservatism tends to cause the retention of lower-case on fascia, traffic signs, etc. It would indeed be ironical if we were to abandon our own superior style, and accept an unnecessary restriction through uncritical imitation.

Lower-Case Confusion

Protagonists of lower-case argue that the irregular shape of words is an aid to recognition. This is undeniable in ordinary reading, but superfluous when, as on signs, horizontal eye-movement is not an issue. On the contrary, dependence on mere shape can here be dangerous; there is plenty of room for confusion, particularly between names with the same or similar initials, since the initial is inevitably prominent in a lower-case system, e.g.

Longtown	Dereham	Portreath
Langholm	Downham	Redruth

It is unlikely that the standard Ministry of Transport capitals are the best possible for the special conditions on motorways. Emphasis on internal areas and stroke endings would certainly help legibility at a distance. Here is another advantage of capitals. There is nothing much to be done to increase the recognizability of a 't' (for instance), except enlarging and thickening; the significant features of a 'T', however, can be accentuated almost indefinitely by an experienced letterer.

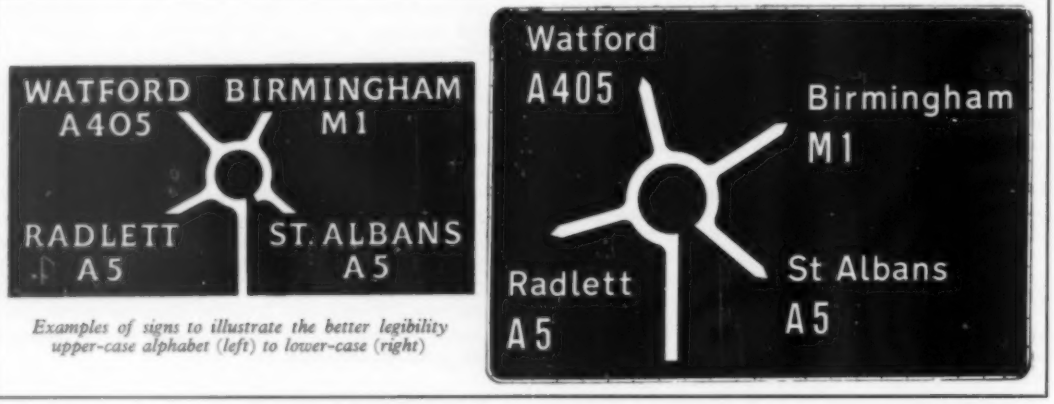
American Research

Some research has been carried out by T. W. Forbes, of the Institute of Transportation and Traffic Engineering at the University of California. He conducted experiments which suggested that lower-case signs used in California were more legible than signs in capitals, but they actually showed that words set in 13 inch capitals were equal in legibility to lower-case words with a 12 inch 'x' height, in spite of a larger initial capital on the lower-case, and, of course, ascenders and descenders.

D. C. Patterson and M. A. Tinker of the University of Minnesota, in their research into the legibility of newspaper headlines, found capital letters very much more legible when seen at a distance. In Germany, often quoted as the champion of lower-case road signs, no comparative research between upper and lower-case letters has, to my knowledge, been undertaken.

Misleading Height

In fact, the overall height of the lower-case alphabet used on the M1 is 22 inches, measured from the tail of a 'p' to the top of a 'd'. Now in the case of capital letters, legibility is not improved by increasing the inter-linear space beyond a third of the letter-height. Clearly then, even the most extreme believer in lower-case lettering for place names must admit that the vertical space needed for a sign in capital letters is very much less.



Examples of signs to illustrate the better legibility upper-case alphabet (left) to lower-case (right)

Apart from the ill-chosen type, the height of the sign is still further exaggerated by large areas of wasted space, resulting from the off-centre and asymmetrical contemporary typographical fashion.

Returning now to my points about legibility:

1. Attraction

When signs are small, it is an undoubted fact that the target area fulfills its function best if white. Obviously, very large signs need different treatment, and in these circumstances the lettering itself should become the target. The letters should be as white as possible, thus helping to reduce to a minimum the period between seeing a sign and perceiving its message. The motorist tends to examine the sign until he understands its message, thus reducing meanwhile his attention to the road.

2. Spacing

The letters must be widely spaced, and a spacing system is essential when one considers mass-production by manufacturers who know little about it. A system should be introduced for their benefit.

3. Large inside shapes of letters

It has been found that legibility depends enormously on the size of inside shapes. It is interesting here to note that eight letters are similar in lower- and upper-case, while 10 capital letters have counters or inside shapes that are equal to, or larger than, those of lower-case letters, and eight lower-case letters have larger counters than capitals. I am, of course, comparing lower-case 'x' height with capitals, since the ascenders, descenders and dots of lower-case only help legibility when the word-pattern is a familiar one, which is generally not the case in place names.

4. Definition of letter-stroke termination

Try reading a page of sans-serif lower-case, and then a page of 'normal-face' and you will see at once that the normal one is more readable. The reason for the existence of the serif is clear, and is not just a meaningless tradition. In very small type, or in larger letters to be read at a great distance—in fact, wherever there is a question of distance in relation to size—there is always a loss of definition. The serif reinforces the individual character of the letter exactly where this loss is greatest.

5. Size

All other points being perfected, size remains a matter for testing. Some motorway signs are 500 square feet, as big as the front of a council house, and stand, perhaps, 30 feet high. It should be further remembered that all signs stand five feet clear of the ground.

Any testing carried out before the new form of sign was put forward by the 'Sign Committee' was quite clearly inadequate. So sure were some members of the superiority of lower-case lettering that they did not even compare it with capitals. This is a serious matter from any point of view. It has been admitted that the saving in cost would be considerable if the size of the motorway signs could be reduced by one-third.

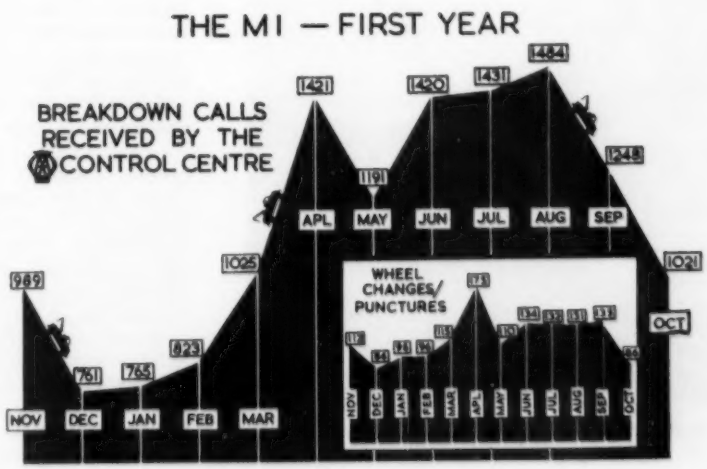
The present motorway letter was designed from very limited data, having been taken over from type designed for less exacting purposes. The road numbers, together with their letters, are even worse than the main alphabet, and do not conform with the simplest rules of legibility or differentiation. The Road Research Laboratory is now making the first valid test ever to ascertain the real difference in legibility between upper- and lower-case place names. The research includes 50 signs supplied to them in the standard M.O.T. letters, and a seriffed alphabet. These and lower-case signs are all to be tested, and I feel very strongly that no decision should be finally and publicly announced on the M1 signs until the facts are established by the Road Research Laboratory.

Example of the Underground

That scholarly and distinguished calligrapher Edward Johnston undoubtedly worked with sympathetic understanding when he produced his letters for the Underground which found their way on to our roads. Apart from their size, which is not his fault, they still serve us well. He favoured capitals, and although the best form of capital probably still awaits a designer, it should be remembered that the real way to tackle a design is to assemble as data all the requirements. The end result is then as near to truth as we can make it. I believe the central mistake behind much modern industrial design is to be found in the pursuit of aesthetics rather than truth. This philosophy is without doubt responsible for the present motorway signs.

To the eyes of some, a sign produced in accordance with the demands of all the assembled data may not at once appear beautiful, and artists are the first to realize this. It can however be proved that all the sign requirements of high speed travel can be best fulfilled by the retention of capital letters: costs are reduced, and the impact of signs upon the landscape is less violent.

BREAKDOWNS ON M1



The Automobile Association prepared the accompanying diagram showing breakdowns on M1 during its first year. Over 13,500 vehicles called for assistance representing about 40 a day. Since five million journeys have been made over the road during this period the chances of breaking down are about 400 to one against, in the estimation of the AA. Main cause for breakdowns were punctures with electric troubles second and petrol feed or pump difficulties third.

AMERICAN REPORT

DESIGNING BETTER FREEWAYS

by George A. Hill

District Engineer California Division of Highways

Fig. 1. Example of ramp design to eliminate weaving.

This article discusses some of the problems that arise in regard to the geometric design of motorways and how they can be met in order to provide the greatest possible traffic capacity. It is based on a talk given by the author before the Institute of Traffic Engineers Freeway Operations Seminar.

A FREEWAY is usually defined as a divided arterial highway for through traffic with full control of access and generally with grade separations at intersections. A more general and perhaps more expressive definition of a freeway is a roadway which allows free flow of motor vehicle traffic. A free-flowing facility is the principal objective in freeway design.

Sometimes traffic engineers refer to the traffic stream or flow as in hydraulics. Actually, the traffic stream is the movement along the road of a series of objects. These objects are self-propelled vehicles directed by intelligent, skilful individuals. Where volumes are very low, traffic truly consists of individual movement. As volumes increase, the traffic stream may take on some of the characteristics of a liquid; and under extreme volume conditions, gaps reach what drivers feel is an irreducible minimum, and traffic movement may act like particles of sand being forced through a tube. Because of these changing characteristics, a design may be satisfactory under very heavy traffic conditions with slow, perhaps artificially controlled, speeds and alert drivers, but may be entirely unsatisfactory under light, high-speed, less alert driver conditions, and vice versa.

Fig. 2. Emergency use of central reserve owing to absence of hard shoulders.

Driver Factors

There are also important psychological factors involved in the traffic operation of freeways and interchanges. Cornell University has found that driver reaction time varies from approximately fourteen-hundredths of a second, to familiar stimuli, to from one to two seconds where interpretation and judgment are required. The driver can respond to familiar stimuli with almost no loss of time, but there is a considerable lag in response to unusual or unfamiliar situations. Important highway design criteria are that the driver is confronted with a minimum number of simultaneous choices and that ample

warning is given in unusual situations or circumstances. The traffic operational characteristics of a particular facility will vary with the traffic volume, physical characteristics, and psychological conditions which are presented to the driver. Proper design should consider all of these factors. California has been constructing interchanges for over 20 years, utilizing a number of designs. This article will present some of the most important things that have been learned in California relative to improved freeway design.

The introduction of a weaving section at the interchange between major freeways, to provide for left-turn movements is not generally satisfactory. It is also imperative that weaving sections, on any portion of a freeway between on- and off-ramps, be carefully scrutinized to make sure that they provide adequate capacity for anticipated on-off volumes. The weaving problem may also be of major consequence on metropolitan freeways where the distance between on- and off-ramps is not great and traffic volumes are extremely high.

Figure 1, at head of this article, shows a design that eliminates weaving by braiding the ramps.

Shoulder Problem

The use of shoulders on the right-hand side of the roadway is almost universally accepted, especially on heavily travelled, divided freeways. Shoulders on the left side are becoming a necessity. Where shoulders are not available, use of the median for refuge purposes is not unusual, as shown in Figure 2. California's present policy is to provide a 5-foot, all-weather shoulder on the left of all four- and six-lane freeways, and an 8-foot paved shoulder on the left of eight-lane freeways. Recommended median slopes are 10:1, so that for all practical purposes, the present California practice is that full emergency shoulders are available on all divided freeways.

At one interchange, the inside off-ramp provided a very inviting movement, although the through movement was actually the major one: the approaching driver had three choices presented to him almost simultaneously, and this caused considerable difficulty. The design was changed so that the driver was provided with additional time between points of decision, (Figure 3), and advance signing was also greatly improved. Figure 4 shows the required distances between points of decision: on the freeway, where operating speeds are higher, a minimum distance of 1,000 feet; on ramps, where speeds are lower, 600 feet is acceptable.

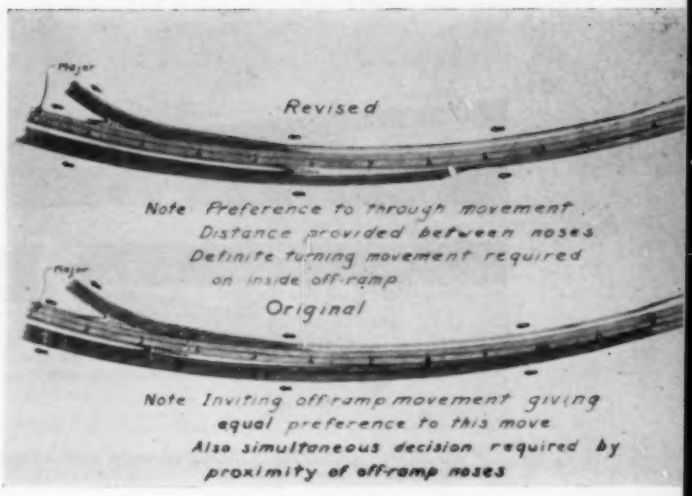


Fig. 3. Original off-ramp design revised to give driver additional decision time.

Design Problems at Interchanges

A design problem frequently arises when an interchange is located in the immediate vicinity of a complicated street intersection pattern. Sometimes it may appear logical to locate an interchange in the immediate vicinity of the intersection of major streets, as these are generally major traffic distributors. However, the addition of the freeway itself and the necessary ramps greatly complicate the existing intersection, and a difficult traffic problem generally arises. It is most likely that extensive and complicated signalization will be required. Design problems sometimes result from the location of a freeway parallel and adjacent to another barrier-type facility such as a railroad. In the past, the location of ordinary highways or expressways parallel and adjacent to a railroad had considerable advantages. When highways are improved to full freeway standards, however, the problems of providing satisfactory interchanges adjacent to the railroad may be of such magnitude that it is more economical to relocate the road away from the railway. Another design problem, with which California has been confronted, is the 'choking' effect of the on-ramp taper which sometimes results from the construction of a tapered on-ramp on a bridge. The bridge rail forces the on-ramp vehicles on to the freeway lanes, and heavy traffic volumes on both the on-ramp and the freeway can create an unsatisfactory traffic condition. Figure 5 shows California's present standards for the treatment of speed-change lanes to eliminate this effect. This so-called 'choking' effect also occurs where a lane is eliminated on the freeway. This 'choking' effect also occurs when a lane is

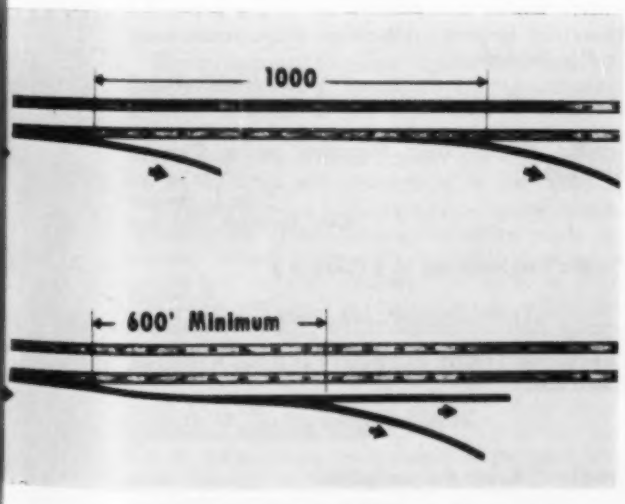


Fig. 4. Distances required between points of decision.

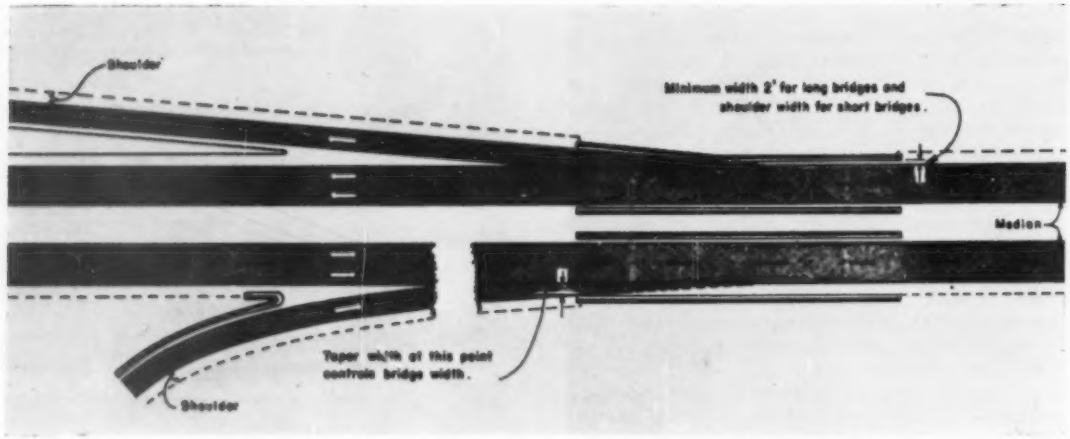

Shoulder
Minimum width 2' for long bridges and shoulder width for short bridges.
Median
Taper width at this point controls bridge width.
Shoulder

Fig. 5. Standard design used in California for speed change lanes on structures.

dropped from a freeway at an off-ramp. Motorists may inadvertently get into the off-ramp and, in trying to get back on to the freeway, create traffic congestion or accidents. Sometimes a tapered section, known as an 'escape hatch', is constructed to permit re-entry to the freeway through lanes beyond the nose of the off-ramp of a freeway.

Ramp Lanes

Where heavy on- and off-ramps are anticipated, it seems logical to use what is called 'balanced design'. That is, a lane is dropped where the off-movement occurs and a lane added for heavy, on-ramp movements. However, the traffic forecasts for ramp movements to date have not been of sufficient accuracy to warrant the dropping of a lane, which requires lane-changing by all traffic in right-hand lanes. Difficulties arise when anticipated ramp volumes do not occur. California's present practice is not to drop lanes on the freeways except when they interchange with another full freeway.

Single-lane on- and off-ramps, when properly designed, can carry as many as 1,800 vehicles per hour. These volumes are as high as it is practical to take on and off the freeway at one point, and the operational characteristics of single-lane on- and off-ramps are far superior to two-lane off-ramps. Present policy in California is not to provide two-lane ramps except at branch-type connections where, in effect, the facility being served by the ramp is of almost equal importance to the freeway itself.

Another important detail of freeway design is the treatment of ramp noses. In years past, ramp noses were allowed to terminate either two feet off the freeway or the full shoulder width. It seems illogical to expend considerable sums to provide a clear shoulder width elsewhere and then constrict the width at ramp locations. All ramp noses in California now must be clear of the full shoulder width.

Summary

In summary, California's experiences indicate the following to be important factors in freeway design:—

1. Avoid weaving sections to provide for major turning movements and scrutinize carefully all freeway designs for possible restrictive weaving sections.
2. Confront the freeway driver with only one decision at a time. Separate decisions by a reasonable distance to allow for reaction time.
3. Turning movements should normally be made from the right lane and should require positive action by the driver.
4. The motorist should be presented with consistent, familiar situations at points of decision.

next month

Glasgow's Traffic Survey

A. G. Jury
City Architect and Director of Planning

Before and After Study—Driver Behaviour at a Signed Roundabout

J. A. Reid
Road Research Laboratory

American Report—American Experience with Traffic Signals

Burton W. Marsh
Traffic Engineering Department, AAA.

Traffic Engineering Practice in a County Borough

John L. Beckett
City Surveyor, Leicester

Traffic Engineering in a County

E. Ogden
Traffic Engineer, Lancashire County Council

Courses on Traffic and Safety at Road Research Laboratory

W. J. O. Scott
Road Research Laboratory

Profile of Keith Summerfield

County Surveyor, Oxfordshire

Visual Aids to Driving

STREET LIGHTING

by GRANVILLE BERRY, M.I.C.E., M.I.Mun.E., A.M.I.W.E.,
City Engineer and Surveyor, Coventry

'Visual Aids to Traffic on Urban and Rural Roads' was the subject of panel discussion at the Fifth International Study Week in Traffic Engineering. Openers of the discussion were Granville Berry and Dr. eng. Hans Lorenz, summaries of whose statements are given below.

VISIBILITY on the road is mainly dependent on brightness contrast, and as daylight fades and night approaches drivers begin to lose the sense of depth and colour, and the usual street backgrounds, such as kerbs, fences and walls, as well as the position of junctions, bends and intersections, become less clearly defined and tend to disappear into the dark background.

Levels of light during daylight hours are naturally very much greater than are possible at night with known forms of street lighting, but, from the standpoint of road safety and driver comfort, street lighting is generally preferred to vehicle lighting. In the latter case the vehicle's headlamps illuminate any obstacles on the road in front of the driver, while in the former they are generally seen clearly as dark silhouettes against the lighted road surface without the necessity of headlights being employed.

Street lighting therefore makes for safe and comfortable driving conditions during hours of darkness and allows the vehicle to be driven at reasonable speed, with safety, by providing the driver with a clear view of other vehicles and objects ahead, and of the limits and deviations of the road itself.

With the increase in the number of motor vehicles the need for street lighting on urban roads has become almost universally recognized. As the standard of lighting increases, the value of other visual aids used such as 'catseye' studs, reflex signs and edge markings, which depend for their success on reflection from vehicle headlamps, become less effective or no longer necessary.

Growth of Traffic and Accidents

The extent to which roads should be provided with street lighting, as well as the standard of lighting required, should be related to the numbers and density of motor vehicles using the roads.

In the last 40 years, while the purpose and importance of street lighting has been undergoing a fundamental change and the development of modern light sources has made its provision economically possible, the basic road pattern of most large towns and cities has changed little, and now has to carry a greatly increased volume of traffic.

The problem of increasing traffic on the roads is, of course, one that faces most countries today, and the need for improved visual aids to driving is more acute when the density of traffic is greatest. As will be seen from Table I, which gives an approximate indication of the number of motor vehicles per mile of road in the U.S.A. and the principal countries of Western Europe, the greatest density of road traffic is in Great Britain, followed by Western Germany, Netherlands and the U.S.A.

TABLE I

Density of Traffic on Roads (1958)

Country	Motor Vehicles per mile of road
Belgium	19.2
France	12.3
Germany (Western)	27.6
Great Britain ...	30.9
Italy	15.8
Netherlands ...	25.9
Switzerland ...	16.5
U.S.A.	20.3

With the increase in the number and density of motor vehicles on the roads there has been a rise in the number of road accidents. Figures for 1957 in the seven European countries shown in Table I are given in Table II and from these it will be seen that the greatest number of road fatalities was in Western Germany, followed by France, Italy and Great Britain, in that order.

TABLE II
Road Casualties in European Countries (1957)

Country	Killed	Injured	Total
Belgium	925	62,773	63,698
France	8,517	183,750	192,267
Germany (Western)	12,462	353,370	365,832
Great Britain ...	5,550	268,308	273,858
Italy	6,936	148,421	155,357
Netherlands ...	1,701	39,514	41,215
Switzerland ...	1,127	29,467	30,594
U.S.A.	38,500	1,400,000*	1,438,500*

**Approximately*

In Great Britain the number killed on the roads during hours of darkness in 1958 was 2,596, or over 43 per cent of the total fatalities, while in the U.S.A. in 1957 54 per cent of all fatalities occurred at night.

British and Continental Practice

The most important differences that exist between British and Continental street lighting practice arise out of the question of glare, and while most British street lighting in the past has employed non-cut-off lanterns with high or medium beam angles, the Continental system makes almost universal use of full cut-off lanterns with low beam angles.

Although the British Code regards glare as being undesirable, and makes certain recommendations aimed at minimizing its effects, it has never been regarded as a significant factor in regard to road accidents, and a good standard of visibility is provided even though some glare is present. In recent years, however, there has been a tendency in Britain to use a semi-cut-off fitting which effects a reduction in discomfort glare without creating a 'tunnel' effect or greatly increasing the number of lighting columns. It may well be that the final solution, as so often happens in the design of lighting installations, will be a compromise between the two systems.

In some recent Continental street lighting installations, however, it does appear that lighting techniques are rapidly approaching those adopted in the design of interior lighting schemes, and that greater reliance is being placed on lighting objects on the road than in obtaining better contrast with the road surface. The results provide satisfactory but somewhat expensive installations.

In Great Britain the adoption of the principle of silhouette vision has made it possible to light the national road system to a reasonably high standard at relatively low cost, over 50,000 miles of roads being nightly illuminated by over 1½ million street lamps, and more than 5,000 miles of main roads having been provided with new or improved lighting in the last 10 years.

While it is somewhat difficult to compare silhouette lighting with lighting which depends on direct illumination of objects on the road, the indications are, based on recent American research, that about twice as much light is required as in the case of silhouette lighting if satisfactory results are to be obtained, and that the level at which it overtakes silhouette lighting probably coincides with peak traffic hours when vehicles are travelling nose to tail.

It has, of course, never been denied that there are some disadvantages to silhouette or 'poverty' lighting, as our American colleagues have dubbed it, and with the post-war tendency to provide dark non-skid road surfaces in urban areas, it has become more difficult to make road surfaces appear bright and there has been some loss of brightness contrast, which is essential for good visibility.

The recent development of 200W and 280W sodium lamps has, however, further improved the standard of street lighting installations, and dual lamp lanterns are already being used at increased mounting heights (35 ft.) on the new Inner Ring Road in the City of Coventry.

Lighting for Peak Hour Traffic

In peak hour traffic conditions in city streets very little of the road surface is seen, and under these conditions the silhouette system has to rely on vertical and other backgrounds and cannot apply to the same extent.

Although pedestrian and vehicular traffic under such conditions is only moving slowly, the adoption of higher standards of lighting are necessary, particularly during limited peak hour traffic periods, and will continue to be so until such time as the roads have been widened to enable them to take the increased volume of traffic.

In order to meet this very limited need which will, in many cases, not extend to a period of more than two or three hours a night, it is not necessary to abandon the principle of silhouette lighting, with the consequent serious delay it might have to the re-lighting of our highway system.

In the author's view, the practical and economic solution of peak hour lighting lies in the direction of stepping up the standard of lighting for the duration of the peak period only, and experiments on these lines are being carried out in Coventry. In a main shopping street in the City Centre, provided with fluorescent lighting in accordance with the British Standard Code of Practice, additional tubes have been introduced into the existing lantern so as to increase the light output from by 60 to 100 per cent. Similarly, in a principal residential road carrying peak traffic when the factories close at about 5.0 p.m. (1700 hours), twin 140W sodium lamps (end to end) are employed to increase the peak light output by 100 per cent.

In the present experiments the additional lighting units are switched in or out by time clocks set to known peak traffic hours. In any permanent arrangements of this sort, however, it is envisaged that by the introduction of detector pads and traffic counters the period of increased light output would be automatically controlled by the traffic the road is carrying, such an arrangement providing a more flexible and satisfactory system than the one being employed in the trial installation.

There are many factors that affect the selection of the most suitable type of lighting installations for different classes of road. In the case of ring roads around cities and the main traffic roads (or radials) that lead out from the city centre, filament lighting can no longer be regarded as a suitable or economic light source when compared with sodium, mercury or fluorescent lighting, and in this class of road good colour rendering is, in general, of little importance.

The high cost of fluorescent lighting renders it

Optical Guidance on Motorways

by Dr. eng. E.h. Hans Lorenz, *Chief Government Building Adviser, Nurnberg, German Federal Republic*

ON railways, the vehicle is guided by rail and flanged wheel. An exact organization with programmes and variable signals ensures that the track is free for each train. The driver of the locomotive is acquainted with the run, because he travels over it every day.

On motorways, these advantages are not available, and in addition, over its length there are many vehicles travelling at different speeds, necessitating overtaking. The driver can only govern his action according to the optical impression which he obtains from the course of the road and the vehicles in front of him. His action depends on optical guidance.

It is a great advantage if the carriageway lies perfectly visible to the driver's eye over a long distance. It is still better, if the road thus clearly visible is uniform and has no places where a sudden change of speed is required that cannot be correctly estimated according to the optical impression. It is best if the course of the carriageway is indicated not merely by the running surface, but evokes in the driver the idea of running space, for the human being is particularly receptive to this. A stereoscopic effect should be provided by plantations and slopes and in cuttings, and by supporting walls.

The surface of the road consists of dips, hollows, rises and gradients. Dips and the gradients leading to them are good for vision, but hollows are unfavourable but unavoidable. The layout consists of curves and straight stretches. Unfavourable for vision, but unavoidable, are the blind curves leading round a projecting rock or wooded height. When the carriageway is rendered invisible by hollows and blind curves its course should be made visible in the third dimension by plantations, forest edges, cutting slopes etc.

By night, in the light of the headlamps, long distance visibility is available. Space or stereoscopic guidance is particularly important here.

In rain, fog, snow-flurries, and particularly at night, the optical impression is confined to the very close vicinity. The main effect is now provided by light coloured guide lines at the edge, guide lines along the centre of the roadway, light coloured guide posts and reflectors (catseyes) and plantations and woods whose edges are close enough to the roadway for the light of the headlights to illuminate them.

One modern problem is the correct proportion of artificial guide devices. The psychological effect of guide posts and reflectors is greatest if these devices are confined to danger points. Their uninterrupted use for hundreds of kilometres can be tiring or disturbing and reduce the alarm effect. Their correct use is an interesting problem.

Optical orientation is good if a junction, seen from the motorway, can be discerned at a great distance. This is best obtained if the junction lies clearly visible in a dip. If this is not possible, it should be discernible by conspicuous plantation and, *vice versa*, be visible in large forests as a large clearing. In the vicinity, the exit from the motorway should be made particularly visible. Optical guidance by planting or cutting the slopes must show the course of the exit. Access to the motorway also requires optical guidance, and the predominant factor is free visibility in the driving mirror of vehicles already on the motorway. Therefore, there should be no plantations that may impede vision.

The connecting slopes at junctions between the motorway and the country road or street are little roads in themselves, and throughout their length, and especially at either end, all optical requirements at roads and intersections must be met.

Optical guidance is not a thing *per se* like a bridge or a road surface, but is the art of arranging everything so that drivers are automatically adjusted to it.

Street Lighting, *Continued from page 470*

less satisfactory than either sodium or mercury, and the former, with its characteristic yellow light and good contrast and absence of glare, is particularly suitable for this class of road. In the case of ring roads, sodium also has considerable directional value and traffic is, in many cases, directed to follow the yellow light. In principal shopping streets a white light is, in general, preferred to the yellow light of the sodium lamp, and in this class of road much greater light output is usually demanded than is required purely for traffic needs.

In Great Britain fluorescent lighting has largely superseded filament lighting for such shopping streets, and, in many cases, higher light output, together with good colour rendering, is now being achieved by the use of colour corrected mercury lamps.

While street lighting is in itself the biggest single factor in ensuring good visibility at night, it is essential if drivers are to gain visual confidence on the road that they can not only quickly and easily recognize the street layout that lies ahead of them, but that directional and other signs are precise and easily read. In many cases, illuminated signs or street names are incorporated into the base of street lighting columns or into the panels of illuminated bollards which are now often lighted continuously by miniature fluorescent lamps.

The final answer to the effectiveness of visual aids for drivers is to be found in the accident records and, in general, the higher the standard of lighting provided, the lower will be the accident figures and the easier will it be for drivers to travel in safety and comfort on even unfamiliar roads.

Access roads under construction in conjunction with the additional lower deck to the George Washington Bridge, New York.

DEVELOPMENTS

A new sign on A1 near Grantham. The colour, Interstate Green, is new to this country and is for use on improved trunk roads.

A view of the newly opened Ross Motorway, showing the Bridstow Bridge in the Wye Valley.

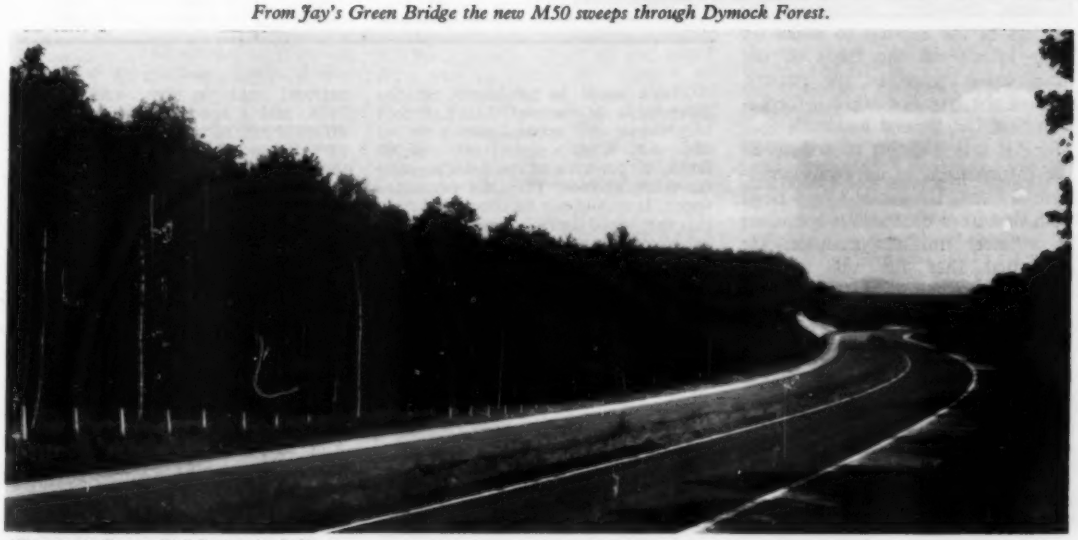
(Photograph: Tarmac Civil Engineering Ltd.)

The Alexander Hamilton Bridge due for completion in 1963, will provide an additional crossing over the Harlem River in New York.

ILLUSTRATED

Compared with the sign shown opposite, this one is erected before a roundabout. Photographs by Franco Traffic Signs Ltd.

From Jay's Green Bridge the new M50 sweeps through Dymock Forest.



(Photograph: Tarmac Civil Engineering Ltd.)

SPEED, FLOW and ACCIDENTS

R. J. Smeed, B.Sc., Ph.D., F.R.S., A.I.C.E.

Dr. R. J. Smeed listening to the discussion on Theme VI, 'The Influence of Speed Regulations on Traffic Flow and Accidents', for which he was General Reporter. His report, summarized by him for Traffic Engineering & Control *is published below.*

DR. Smeed opened by stating that they were discussing the most comprehensive set of data on the subject of speeds and speed limits that had ever been collected together. Some of the 18 papers to be considered discussed the effect of speed limits on the speed of traffic, some the effect of speed limits on accidents in urban areas and some the effect on accidents in other areas. Some dealt with factors other than speed limits that affect the speed of traffic. Only a few made clear, explicit statements about the effectiveness of speed limits, about which they wrote; but about one-third could be said to conclude that speed limits were effective and about one-third that they were ineffective. The remaining third had rather mixed opinions. It was, therefore, necessary for readers of the reports to make up their minds on the basis of the information given in the papers, and on the basis of other information that Dr. Smeed had collected. Since it was difficult to collate all the information in an easily intelligible form, Dr. Smeed had dealt with that from the various countries in a fairly uniform manner. He explained that his talk was a condensed version of the written report which delegates had before them and which would be published in due course.

Effect of Speed Limits on Traffic

Because the influence of speed and speed regulations on traffic flow and accidents covered many aspects, Dr. Smeed discussed them separately and began by considering the effect of speed limits on the speed of traffic.

M. Lefevre's paper on the effect of a speed limit on speeds in Belgium stated that at the end of 1958 in Belgium, a speed limit of 80 km/h was imposed in the evenings of week-ends and public holidays. The paper gave the results of an investigation into the speeds of traffic in 1959 at times when the speed limit was both in force and not in force. Some of M. Lefevre's data are summarized in Table I.

TABLE I

Effect of Speed Limits on Speeds (1)

Country	Speed Limit (km/h)	% Vehicles Exceeding (km/h)	Before	After
Belgium	80	80	51	38
Netherlands	50	50	77	40
		60	42	7
France	80	80	40	24
France	90	90	22	13
		100	9	3

There could be no doubt of the correctness of one of M. Lefevre's conclusions that speed limits were not observed. With a speed limit of 80 km/h, 38 per cent of the vehicles were travelling at more than the permitted speed. It should not be concluded from this that speed limits had no effect. The vehicles might have been travelling even faster if no speed limit had existed as was in fact suggested by the measurements made by M. Lefevre, which showed that the apparent effect of the speed limit was to reduce the proportion of vehicles travelling at more than 80 km per hour from 51 per cent to 38 per cent.

Dr. Smeed then considered the paper by the Netherlands ad hoc committee which gave information on the effect of the speed limit of 50 km/hour, imposed on most motor vehicles in built-up areas in November 1959. The proportion of vehicles driven at speeds greater than this limit was reduced from 77 per cent to 40 per cent: it was approximately halved after its imposition. The proportion driven at speeds in excess of 60 km/hour was reduced from 42 per cent to seven per cent, by five-sixths.

Dr. Smeed said that M. Goldberg reported that in France a speed limit of 80 km/h was imposed on certain national roads on three week-ends in 1958, and a speed of 90 km/h on a different set of national roads during 11 week-ends of 1959. Information of the effect on speed of these limits were summarized in Table I. Many drivers disobeyed the speed limit but, apparently, the law had a very marked effect. In 1958 the number of drivers travelling at more than 80 km/h was nearly halved. During 1959 the number travelling at more than the new limit of 90 km/h was reduced by 40 per cent, the number travelling at more than 100 km/h by two-thirds.

Dr. Baerwald's paper discussed American experience of speed limits and gave views on them of many American traffic engineers. This paper made the assumption that at least 85 per cent of the drivers were travelling at safe speeds. Therefore, if the maximum speed limit was near the

85 percentile speed, the enforcement attention could be focused on the faster 15 per cent. Dr. Baerwald concluded that speed limit signs, as such, did not have a material effect on driver behaviour, and that drivers would usually ignore speed limits which they considered arbitrary and unrealistic. He gave data and references to information from a total of six reports to support his conclusions. These reports had been examined and summarized by Dr. Smeed. (See Table II).

TABLE II

Effect of Raising Speed Limits (U.S.A.)

Change in:—		
Speed Limit (mile/h)	Mean Speed (mile/h)	85 Percentile (mile/h)
34 to 39	+1.1	+0.5
30 to 34	—0.3	+1.0
34 to 39	+1.0	+1.8
30 to 35	+0.7	+1.5
30 to 40	+0.4	+1.0
Various	+1.0	+0.6

Some of the information was omitted from this table, either because it was considered to be unsatisfactory for the reasons given in the written report or because the before and after speeds were almost the same. In almost every case remaining the raising of the speed limit resulted in the raising of the average speed of traffic, although by only a small amount.

Tables IIIa and IIIb gave some information on speeds before and after the imposition of speed limits in the U.S.A. Establishing a speed limit seemed to have had a marked effect on lowering speed in every case.

TABLE IIIa

Effect of Establishing Speed Limits (U.S.A.)

Speed Limit Established (mile/h)	Change in 85 percentile (mile/h)
35	—5
35	—7
Various	—3.6
Various	—3.0
Various	—3.5

In the cases shown in Table IIIb lowering a speed limit, lowered speed. It had a negligible effect in two other cases which for simplicity were omitted from this table, but which were given in the written paper.

TABLE IIIb

Effect of Lowering Speed Limits (U.S.A.)

Speed Limit Lowered (mile/h)	Change in 85 percentile (mile/h)
60 to 45	—2.5
50 to 40	—0.5
Various	—3.2

Those cases in which the change was small or data unsatisfactory have been omitted.

Dr. Baerwald's data could perhaps be summarized by dividing them into two parts: one provided no evidence that speed limits had any effect on speed, the other suggested that abolishing speed limits raised speeds, and that either establishing or lowering a speed limit lowered speeds. Dr. Baerwald concluded that speed limit signs do not have a material effect on driver behaviour, but it seemed to Dr. Smeed that this conclusion was not supported by the data.

Table IV gives the effect of the imposition of a speed limit on speeds in the United Kingdom. A speed limit of 30 mile/h was imposed on the roads of the built-up areas of Northern Ireland in October 1956.

TABLE IV

Effect of Speed Limits on Speed (2)

Country	Speed Limit (mile/h)	% Vehicles Exceeding (mile/h)	Before	After
Northern Ireland	30	30	59	16
		40	18	1
Britain	40	40	39	24
		50	8	1
Britain	50	50	28	11
		60	7	1
Britain	30	30	52	46
		45	2	1

The apparent effect of the speed limit was to reduce the number of vehicles travelling at more than 30 mile/h, from 59 per cent to 16 per cent, or by three-quarters. The number of vehicles exceeding 40 mile/h was reduced to one-eighteenth of its former value.

A 40 mile/h limit was imposed on a number of main roads in the London area on an experimental basis in March 1958. Table IV showed that after the imposition of the limit there was a drop of about 40 per cent in the percentage of drivers exceeding 40 mile/h. The percentage of drivers exceeding 50 mile/h decreased from eight to one.

Similar results were obtained after the imposition of a 50 mile/h speed limit at weekends and public holidays and after the imposition of a 30 mile/h limit in a number of villages on main roads.

Effects of Speed Limits on Speed

Dr. Smeed then considered what general conclusions could be drawn from the information so far considered. The first was clear: speed limits were disobeyed on an enormous scale. In every case for which there were data, an appreciable or large proportion of vehicles exceeded the speed limit. Despite this, speed limits nearly always affected the speed of traffic, and the number of vehicles travelling at high speed was usually considerably reduced.

Whether it was desirable to use a method of controlling speeds that was disobeyed on an enormous scale was a matter for discussion. It should not, however, be said, as had been implied in several of the papers, that speed limits had no effect on speed: it was usually considerable. This conclusion applied to every country for which they had information.

Effects on Accidents and Casualties

The next point to be discussed was the effect of speed limits on accidents and casualties, and Dr. Smeed dealt first with the effect of these limits when imposed on all roads of large areas, usually urban areas.

On September 1, 1957, a speed limit of 50 km/h was imposed on all vehicles using the roads of the built-up areas of the Federal Republic of Germany. The four papers dealing with the effects of this did not all reach the same conclusions. The Chief of Police of West Berlin, and the Ministry of Economy and Transport of North Rhine Westphalia were convinced that the speed limit resulted in a marked improvement in the accident situation. On the other hand, the Chief of Police of Hamburg and Herr Kopp suggested that part or all of the improvement in the accident position was due to other causes.

Figure 1 gives some data on the subject. The firm line shows casualties and accidents year by year in the built-up areas of the Federal Republic. The dotted lines give these data for non-built-up areas. For ease of interpretation the scales are made different for the four lines.

Between 1953 and 1956 the numbers of casualties and of total reported accidents increased at about the same rate in built-up and non-built-up areas, but after 1957 changes in built-up areas were out of line with those in non-built-up areas. The casualties and accidents in non-built-up areas continued to

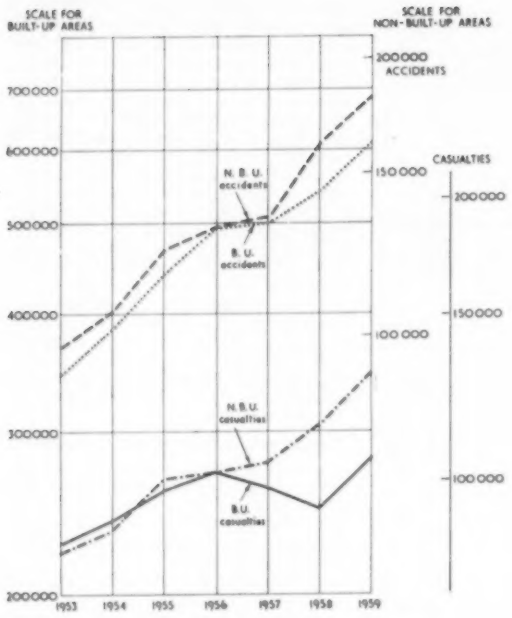


Fig. 1. Accidents and casualties in the German Federal Republic.

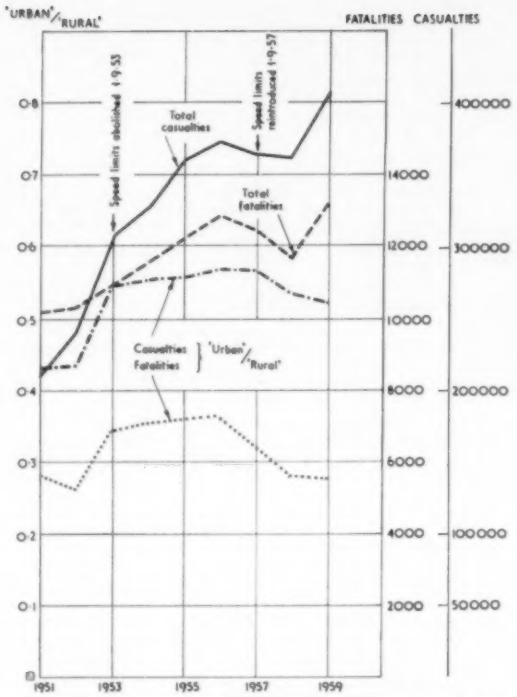


Fig. 2. German Federal Republic, Casualties and Fatalities, 'Urban' and 'Rural'.
'Urban' = Town with population of more than 100,000.
'Rural' = All other areas.

increase but in built-up areas there was a fall in 1957, i.e. in the year the speed limit was introduced and, in 1958, there was a further fall. In 1959, the casualties started to rise again. The total number of reported accidents in built-up areas did not fall after the introduction of the speed limit but it fell relative to the number in non-built-up areas. It seemed natural to suppose that these changes in the accident position were associated with the introduction of the speed limit which occurred at about the same time. This conclusion was strengthened by the information given in Fig. 2. This shows the numbers of casualties and fatalities in large urban areas related to the total numbers in other areas year by year since 1951, i.e. it gives the rate

$$\frac{\textit{number in large urban areas}}{\textit{total number}}$$

year by year. The proportion of casualties and fatalities occurring in large urban areas was low in 1951 and 1952 and 1958 and 1959, but high in the intervening years. The speed limit was abolished in the German Federal Republic on September 1, 1953, and reimposed September 1, 1957. Hence, during the time that a speed limit existed in urban areas the proportion of casualties and fatalities occurring in urban areas was low and, when the speed limit was abolished, the proportion of casualties and fatalities in urban areas was high. There was, therefore, good reason for believing that the speed limit had a favourable effect on accidents in the Federal Republic of Germany.

Since there was insufficient time to discuss in detail the information on each of the other countries for which there were data, the results were summarized and are given in Table V.

A speed limit of 60 km/h was imposed in the built-up areas of Switzerland on June 1, 1959, and Herr Ramseyer had given information on the effects of this on accidents. By assuming that the previous trends in the accident rate in built-up areas relative to those in non-built-up areas would have been maintained if not for the effect of the speed limit, it was possible to estimate the effect of the speed limit on casualties and accidents. The results are given in Table V. The apparent effect of the speed limit was to reduce the total reported accidents by two per cent, injuries by six per cent and fatalities by 21 per cent.

A similar result was obtained by the ad hoc committee who studied the effects of the speed limit imposed in the built-up areas of the Netherlands in 1957. There, the apparent effect was to reduce slight injuries by six per cent and serious injuries by 10 per cent.

Messrs. Grahn and Rempler had reported that a nationwide speed limit of 50 km/h was imposed in the built-up areas of Sweden in July 1955. A unmber of other steps were taken simultaneously to increase safety, and there was a marked reduction in accidents in both non-built-up and built-up areas. The introduction of the speed limit was followed by a reduction of 11 per cent in serious injuries in biult-up areas.

In Belgium, speed limits of 60 km/h in built-up areas and 80 km/h on week-end evenings were imposed at the end of 1958. M. Lefevre had given the results of an investigation he had made into the effect of these speed limits on accidents. He found a very high correlation between accidents in built-up areas and the volume of traffic and concluded that '1959 cannot be con-

TABLE V
Effects of Speed Limits on Accidents in Urban Areas

Country	Percentage changes		
	Accidents	Injuries	Serious injuries
Switzerland	—2	—6	—21*
Netherlands		—6	—10
Sweden			—11
Britain		—3	—15*
N. Ireland		—25	—34
German F. R.	—11	—18	—30*
Jersey		—8	—39

*Fatal

sidered as different from previous years and no conclusion can be drawn as to whether accidents showed a marked decrease as a result of the introduction of the speed limit.' However, it had been shown that speed limits had a much bigger effect on the numbers of fatalities than on total accidents. 1959 was the first year since 1953 in which a reduction in fatalities occurred in Belgium. Since reductions in the numbers of fatalities were something which normally occurred when speed limits were imposed, it seemed likely that this reduction was associated with the introduction of the speed limit. If M. Lefevre had analysed data on fatalities instead of on accidents, he might have found that the speed limit had an effect.

A speed limit of 30 mile/h was imposed in the built-up areas of Great Britain on March 18, 1935. Some data relevant to this are given in Table VI.

TABLE VI

Effect of Speed Limits in Built-up Areas of Great Britain introduced March 18, 1935

Year	Registered motor vehicles in September (thousands)	Fatal Accidents	Personal injury Accidents
Mar. 1932—Feb 1933	2,227 (93)	6,386 (89)	181,823 (88)
Mar. 1933—Feb. 1934	2,285 (95)	7,148 (99)	195,498 (95)
Mar. 1934—Feb. 1935	2,405 (100)	7,207 (100)	205,907 (100)
Mar. 1935—Feb. 1936	2,570 (107)	6,118*(85)	194,028*(94)
Mar. 1936—Feb. 1937	2,758 (115)	6,452 (90)	199,465 (97)
Mar. 1937—Feb. 1938	2,929 (122)	6,441 (89)	197,170 (96)

**Actual figure reduced by* 1/366 *to make allowance for leap year. The numbers in brackets are the numbers in the various columns related to the year* 1934-35 *as* 100.

Despite a normal increase in the number of registered motor vehicles, the number of fatal accidents fell by 15 per cent in the year following the imposition of the speed limit. The total number of personal injury accidents fell by 6 per cent. The number of those killed had never again reached its 1934 value, despite the fact that there were in 1959 nearly three and a half times as many vehicles using the roads as there were at the time of the imposition of the speed limit.

A number of other changes were made simultaneously with the introduction of the speed limit. However, the speed limit was the only one of which the effect would be likely to be sudden. It therefore seemed desirable to investigate whether a sudden change in the accident position did occur. The matter is investigated in Table VII.

Table VII shows that both fatal accidents and all personal-injury accidents per day were higher in January and February 1935 than they were in the corresponding months of 1934. These accidents were, however, lower in March-December 1935 than they were in March-December 1934. It therefore appeared that the sudden change from a rising trend in accidents to a fall could reasonably be ascribed to the introduction of a speed limit in built-up areas. Any other view was made almost untenable by the data on changes in accident frequency in town and country areas given in Table VIII which shows accidents in town and country police districts: unfortunately data for built-up and non-built-up areas were not available.

TABLE VII

Accidents per Day

	Jan.—Feb.	March	April—Dec.
Fatal accidents			
1934	16.9	17.4	20.4
1935	17.7	13.1	17.7
1936	14.5	13.4	18.4
Personal injury accidents			
1934	418	473	601
1935	438	411	572
1936	409	439	585

Despite a normal increase in the number of registered motor vehicles, the number of killed fell immediately after the imposition of the limit and the numbers of injured hardly changed. Between 1934 and 1936 the number of road users killed and injured fell by 11 and two per cent respectively, and had never again reached the 1934 values.

Unfortunately, it was not possible to obtain an exact measure of the effect of the speed limit because information on the number of accidents in built-up areas was not available before the imposition of the speed limit. Accident data were, however, available by police district and, by classifying the various police authorities into town and county forces, an approximate idea of the effects of the change may be obtained. The available data are given in Table VIII.

Thus the introduction of the speed limit was followed by a reduction in fatal accidents of 15 per cent

$$\left(\frac{100\ (1-0.74)}{0.87}\right)$$

and personal injury accidents of three per cent.

$$\left(\frac{100\ (1-1.35)}{1.40}\right)$$

The fact that the roads on which the speed limits were imposed by no means coincided with the urban and rural roads would be expected to mean that the apparent effect of the speed limit was less than the actual effect.

TABLE VIII

Accidents in Great Britain before and after the imposition of a 30 *mile/h speed limit* 1935

Year	Fatal accidents			Personal injury accidents		
	Town	County	Town/ County	Town	County	Town/ County
1931	3,126	3,565	0.88	109,349	71,728	1.52
1932	3,079	3,588	0.86	108,717	75,289	1.44
1933	3,332	3,870	0.86	113,393	78,389	1.45
1934	3,408	3,935	0.87	119,417	85,293	1.40
1935	2,857	3,645	0.78	111,232	84,660	1.31
1936	2,797	3,764	0.74	114,402	84,576	1.35
1937	2,830	3,803	0.74	112,518	83,850	1.34
1938	2,741	3,907	0.70	112,899	82,765	1.36

In every case for which information was available, the imposition of a speed limit was followed by a reduction in serious injuries in these built-up areas relative to serious injuries in neighbouring rural areas. There was also a reduction in the number of slight injuries but this was less than the reduction in serious ones. For countries in which the information was available the speed limit also had an effect on the total number of reported accidents but this effect was smaller than the effect on casualties. Owing to the increasing number of vehicles, however, the number of casualties and accidents had otherwise been tending to increase in all the countries considered. It was hardly conceivable that these marked reductions in accidents, approximately coinciding with the impositions of the speed limits, could be due to any other cause than the speed limit and its associated enforcement, and possibly propaganda associated with it. It must be concluded that in these areas the speed limit had been effective in reducing accidents, especially serious ones.

Types of Accidents Affected

It had been found that speed limits were effective in reducing the numbers of accidents, especially the more serious ones, in urban areas.

It was desirable to investigate if some types of accidents were more affected than others. The Dutch report threw light on one aspect of this matter, the authors of which analysed the accidents according to the kind of road on which they occurred in The Hague and Rotterdam. The results for The Hague are reproduced in Table IX.

TABLE IX
Effect of Speed Limits on Different Roads (The Hague)

	Percentage changes		
	Killed	Serious	Slight
Main Traffic Arteries	—47	—51	—2
Other Roads	—12	—15	+22

The reduction in accidents was much greater on main traffic routes than on other roads. On main traffic arteries, the numbers of fatalities and serious casualties fell by about one-half and slight casualties by two per cent. The speed limit had much less effect on other roads; on these fatalities fell by 12 per cent, serious casualties by 15 per cent and slight casualties increased by 22 per cent. A similar effect was found at Rotterdam. Thus speed limits apparently were much more effective on main roads than on other roads.

Different Classes of Road User

Some information had been collected on the effect of speed limits on the classes of road user casualties. The results are given in Table X.

Table X shows the effect on riders of two-wheeled vehicles. The effect on other classes of road user was more varied. In almost every case the introduction of the speed limit was followed by a reduction in pedal and motor cyclist fatalities.

TABLE X
Effect of Speed Limit on Fatalities

Country	Year	Pedal Cyclists	Motor Cyclists
Sweden	Before	231	260
	After	144	208
Netherlands	Before	411	445
	After	377	484
Northern Ireland	Before	38	36
	After	25	36
Britain	Before	1,536	1,430
	After	1,498	1,187
Belgium	Before	124	187
	After	122	170
German F. R. (Built-up)	Before	3,173	
	After	2,272	

M. Goldberg had supplied information on the effect on accidents of speed limit restrictions at a number of week-ends on certain main roads. The accidents which occurred when the speed limit was in operation had been compared by M. Goldberg with the accidents on the same roads at other week-ends in the same year when the traffic volume was about the same, and also with the corresponding week-ends of the previous year. Whatever comparison was made the conclusions to be drawn were similar.

The numbers of casualties per week-end were fewer when the speed limit was in operation than when it was not. The magnitude of reduction was difficult to estimate but the different comparisons all gave reductions varying between five per cent and 30 per cent.

There were two reports on the effect of speed limits on the German autobahnen. The Ministry of the Interior of Baden-Wurttemberg said that a speed limit of 100 km/h was imposed on two sections of the motorways in their area. The report compared the accidents, fatalities and personal injuries one year before and after the introduction of the speed limit on these two sections with corresponding figures for two other sections of the motorway in the same region. Fatalities, casualties and accidents fell in numbers on the parts of the autobahn subject to a speed limit but rose on the other sections where no speed was imposed. In the absence of contrary information, it seemed reasonable to speculate that if the speed limit had not been imposed, the accidents of various types would have changed by the same amounts in the various parts of the motorway. If that was assumed, the apparent effect of the speed limit had been to reduce fatalities by 68 per cent (based on rather small numbers) and injured persons by 38 per cent.

There was a second report on the effect of the speed limit on the German autobahnen from Dr. Heyse. This dealt with the Hesse section of the Frankfurt am Main/Mannheim Autobahn. The annual figures for traffic flow and accidents were given by Dr. Heyse. It was clear that personal injury accidents fell considerably after the introduction of the speed limit although the fall in damage-only accidents was temporary. As Dr. Heyse stated: 'The authority which had introduced the speed limit felt entitled to conclude that its measures had an undoubted success'. Dr. Heyse, however, threw doubt on this conclusion. He said the traffic flow in 1958 was two per cent less than in 1957 when there were unusually high peaks. But two per cent change in flow was small and the change in accidents was large. The high peaks in flow were presumably included in the two per cent. Apparently, therefore, the speed limit had a marked effect in reducing accidents on the motor roads.

When in London the 40 mile/h limit was applied to roads formerly unrestricted, there was an average apparent reduction of 20 per cent on all personal injury accidents and 30 per cent in those that were fatal and serious.

There was thus information on the effect on accidents of speed limit restrictions on certain main roads at week-ends in France, on speed limits on the German motorways, on the effect of a 40 mile/h limit on some important roads of Great Britain. In each of these cases, there was evidence that the introduction of the speed limit coincided with a reduction in casualties. It was known that accidents in these countries rose fairly continuously in the periods before and after the speed limit was imposed. The fact that accidents on the roads fell in number after the introduction of speed limits suggested that their introduction had caused a reduction in accident frequency.

Dr. Smeed said that it must be concluded that the imposition of a speed limit on appropriate busy roads sometimes resulted in a marked reduction in casualties.

(*Concluded on page* 482)

INTERNATIONAL

ROAD SAFETY CONGRESS

THE International Road Safety Congress, organized by the World Touring and Automobile Organisation in co-operation with the International Federation of Senior Police Officers and Prévention Routière Internationale, was held at Nice, following the Fifth International Study Week in Traffic Engineering, from October 3 to 5. Among the large delegation from great Britain was the Joint Parliamentary Secretary to the Ministry of Transport, Mr. John Hay, and Brig. R. F. E. Stoney, Director General of RoSPA. At the close of the Congress a resolution covering various aspects of road safety was passed and reads in part:

The Congress, considering the ever increasing need for road safety in present-day society, stressing that road safety depends on numerous factors, the most important of which are, on the one hand, the condition of the road network which this traffic must use and, on the other hand, the behaviour of road users, recognizing that, in order to behave correctly, the road user must first of all be well informed on the hazards and risks that road traffic involves and must know how to deal with them, stresses the fact that a good road safety education is of the utmost importance;

Recommends that a knowledge of modern road traffic and of the traffic regulations which must be respected in order to ensure safety, should be widely taught in schools, stressing the importance of the proper training of teachers entrusted with teaching road safety in schools, recommends that special courses should be organized on an ever-increasing scale, so as to enable the teachers whose task it is to teach road safety to acquire the necessary knowledge or to improve it, expresses the hope that more and more teachers will be able to follow such courses, and stresses the part which specially qualified traffic police officers may play in this respect;

Considers that driver instruction requires special knowledge and ability and should therefore be given only by fully qualified persons, believes that such instruction should not be limited to driving technique and the traffic rules in force, but should also inculcate in pupils a sense of responsibility, making it clear at the same time that correct behaviour facilitates traffic and is therefore in their own interest, recommends that all countries which have not already done so should adopt appropriate legislative measures in this respect and that driving instruction should be adequately supervised, recommends that, in the light of the very satisfactory results which have been obtained in certain countries, schools giving higher education should provide optional driving courses for those pupils who are old enough to hold a driving licence;

Recognizes the value of special courses for drivers who already hold a licence, especially for those who have been summonsed for infringing the traffic regulations, in which case, these courses could even be compulsory;

Noting the usefulness of safety belts and safety harnesses in reducing the serious effect of certain types of accidents on car occupants, stressing that these safety devices must comply with certain technical standards, recommends that the types of safety belt or harness which have been approved carry a special mark so that buyers can easily recognize them, expresses the hope that car manufacturers continue their efforts to build safety into their cars, for instance by providing as standard equipment the necessary anchoring attachments for safety belts and harnesses, and expresses the wish that propaganda should be intensified to emphasize the usefulness of such safety equipment and the need to use it on all occasions even for short trips;

Notes that the concept of the 'accident prone driver' has recently been subjected to serious criticisms both as regards definitions, research methodology and practical conclusions, underlines that research work up till now has nevertheless produced most valuable material, recognizes that the human factor is of fundamental importance in road safety, stresses the necessity of intensified research in this field, applying improved methods for evaluation of the road safety qualities and behaviour of drivers, pedestrians and other types of road users;

Stresses the need for more scientific studies on all aspects of the phenomenon of road accidents, recommends that closer international co-operation be established in this respect, and notes with satisfaction the efforts already made to this end, and considers it essential that regular contact be maintained both at national and international level between the experts carrying out these scientific studies and all circles concerned with the practical measures and means to improve the free flow and safety of road traffic;

Noting the differences found at present among the regulations concerning road traffic in various countries, realizing that such differences are creating a dangerous situation in these countries especially in Europe, considers it urgent that this situation be improved, approves whole-heartedly the initiative taken internationally with a view to establishing a European highway code, having noted the work undertaken by several countries in Europe with a view to standardizing certain traffic regulations, and expresses the wish that this work be extended to as many countries as possible, that the international organizations which represent the circles directly concerned be called upon to help, and that the maximum effort be made in order to succeed as quickly as possible in standardizing the necessary regulations, which is an essential step towards the adoption of a uniform highway code.

Themes Discussed

Discussion of the principle themes revealed a common concern among motorized countries at the growing toll of road accidents and disclosed that there was a similarity of method in planning programmes and propaganda campaigns to improve safety on the roads. There was a greater realization than previously that the behaviour of the individual was dominant as a contributory factor in accidents, and consequently there was need for more research into the behaviour pattern of road users and the accumulation of data, so that appropriate steps could be taken to condition roads and vehicles and road users to minimize the accident risk.

Speaking on road safety propaganda campaigns, Brig. Stoney said that in Britain campaigns showed that road deaths and injuries in relation to the number of vehicles are respectively a third and a half of pre-war figures and that little change, except for the better, had taken place over the last eight years when the flow of new vehicles into the home market started to become a flood.

'We, however, regard casualty/vehicle ratios as tending to paint too rosy a

picture. We must admit that the numbers killed on our roads today are much the same as pre-war and the number of injured up very considerably. We, therefore, prefer to adopt as a more realistic yardstick, and, incidentally, one we can use to see how we rate in relation to other countries with like problems, the ratio of road deaths per 100,000 population. Here, in spite of the steeply rising numbers of vehicles and, more significantly, of new drivers in all age groups, on our overcrowded roads, the deaths/population ratio has barely risen at all and is still below the pre-war figure. When we compare our ratio with that of the U.S.A. and heavily motorized European countries we find that only Belgium and Norway have a better record to show and some indeed are twice as bad as we.'

Psychological Aspects

The psychological value of short-term and long-term campaigns, was the subject of the paper by Gerhard Munsch, Chief of Medical Psychological Laboratory, Munich, said that he considered from the psychological aspect, RSP frequently makes the mistake of not taking the true mentality of man as a road user sufficiently into account. It is a fact that those responsible for RSP frequently ascribe to the road user faculties and interests, as well as faults, which in reality are non-existent. One proceeds from the unfounded presupposition that for the most part traffic functions according to written regulations and laws that all these regulations and laws are psychologically correct, that man can always observe them if he only has the will to do so, and that man behaves in exactly the same manner in traffic as he does in other spheres of life. But the psychophysical functional conditions as regards traffic participation have in some respects an entirely different character of their own. Experience has shown that one and the same person can be entirely different, that is to say, can react quite differently, according to whether he is engaged in his occupation, or whether he is part of the traffic. This phenomenon is on the whole regarded as a big unsolved riddle. But herein lies the very essence of the RS problem. An RSP will inevitably fail to accomplish its purpose if it tries to solve a riddle such as this be denying the facts themselves, that is, for instance, by acting as if such a peculiarity does not exist, at least, need not exist and, in fact, should not exist.

The limitations and the possibilities of RSP follow automatically if one knows how the average person behaves in traffic, what is expected of him, what his difficulties are, and what interests and rouses him. An effective and well-organised RSP presupposes a clear and realistic answer to the following questions:

(*a*) What does road safety mean to the average person?

(*b*) What are the real causes of faulty road behaviour, and how does the average person in practice manage to avoid accidents?

Speaking on motivation research as applied to the problems of road safety Miss Jean Morton-Williams, Director of Marplan Ltd., said that motivation research was basically a collection of techniques for finding out why people behaved as they did. 'These techniques and the theory on which they are based are derived largely from what the social sciences have taught us about human beings. And the most fruitful sources are, I think, social psychology and sociology, which deal with large groups of normal people in a social situation, rather than clinical psychology and psychoanalysis. The main method used is that of the sample survey and the same rigorous scientific standards must be applied as in other survey work.

'The basic tenet of motivation research, and the justification for it, is that human beings do not have insight into their own motives. So if we ask people *why* they behave as they do, they will give us an answer which appears perfectly plausible on the surface but which can often be demonstrated to be at best a half-truth, and at worst a complete rationalization.

'It is the job of motivation research to sort out all the factors which influence people's behaviour—the factors in their personalities, in their social and cultural characteristics and in their environment—and to evaluate them to discover which are of most importance to the particular problem.

'The ultimate purpose of motivation research is to provide information about *why* people behave as they do with a view to devising means for changing their behaviour in some way. As applied to road safety, the ultimate aim of motivation research would be to gather information which could be used to devise ways of changing the behaviour of road users in such a way that accidents would be less likely to occur.

Road User Behaviour

'The area in which motivation research could make its greatest contribution to the problem of road safety is in the study of those sociological and psychological attitudes which might lead to safe or unsafe behaviour on the roads. This is the sort of information which could be most useful in devising effective propaganda. But it must be remembered that propaganda can include education as well as persuasion and the motivation research could most usefully tie up with and complement the laboratory studies.

'Motivation research can play a useful part in discovering the nature of the resistances to safe behaviour on the road and thus will help in bridging the gap between the laboratory studies and the acceptance and application of their findings by the people concerned so that greater road safety can be achieved.

'The problem of road safety would be tackled by motivation research in this way: firstly, different groups of road users would be defined and further subdivided according to their involvement in road accidents. Then a full study would be made of these groups to see how they differ from each other in terms of characteristics which might be related to their behaviour on the road and their involvement in accidents; the characteristics that would be studied would be factors in their physical circumstances and environment, their sociological circumstances and attitudes, and their psychological characteristics which might include both personality factors and perceptual and motor skills. Thirdly, the images of the different types of road users would be studied in order to discover what type of person each group is demonstrating itself to be by its road behaviour and what attitudes they have towards members of the other groups of road users.'

Courses for Road Users

Education of road users was discussed and extracts from the report given to Congress by the General Reporter, A. E. Forsyth, Assistant Commissioner of Transport, New Zealand, are given, summarizing work done in the different countries which presented reports.

I think it is true that at the present time in every country most drivers of motor vehicles have learned in a haphazard fashion, acquiring their driving habits from a motorist of longer experience, but not necessarily from one who is himself properly versed in correct driving techniques, or knowledge and application of the laws and accepted road safety practices. With the increased volumes and greater speeds of traffic today, not only is greater care and alertness necessary at the wheel than was the case in previous generations but so also is sounder knowledge of proper driving procedure and greater skill in applying this knowledge.

In some countries ever increasing numbers of young drivers are being taught by trained instructors in the classroom and behind the wheel before they leave school. Most of the older drivers have not received the benefit of this kind of training from skilled and experienced instructors. To many of the older drivers, the provision of 'refresher' instruction would represent the first authoritative and reliable guidance that they have ever received upon the subject of traffic.

As yet, most countries are not doing a great deal in providing refresher courses, while even those nations which are most active in this field will, I think, concede that at present they are able to offer refresher instruction to only a small fraction of their road users. Here is some indication of what is being done:

Australia

In Tasmania refresher courses are conducted only by private driving instructors, but in certain of the other Australian states the police provide lectures for some categories of first offenders or for those committing traffic breaches of a minor nature. The National Safety Council of Western Australia has set up a Road Safety Instructional Centre for driver and general traffic training of school pupils. It is proposed to extend the facilities of the centre to provide in addition refresher courses and checks upon visual acuity, reaction and other relevant factors for industrial and commercial transport personnel.

Germany

Dr. Horst Heyse reports that in Germany there are few provisions requiring the further training of a driver who is already licensed, and any such training would normally be available only through driving schools. Nevertheless

the traffic authorities may invite a traffic offender to attend a course of short lectures dealing with traffic problems and behaviour and a driver whose licence has been withdrawn may be required to receive further instruction before his licence is restored. Otherwise any special training is on a voluntary basis and is in the hands of the automobile clubs and other organizations which may offer such tuition.

Dr. Heyse describes a German school for long distance drivers which was founded by the transport industry to provide advanced instruction with the aim of improving the standards of driving of these professional drivers and at the same time improving the public relations of the transport industry with the rest of the road-using community. Each class of about 30 drivers is of one week duration. The school is financed by the industry and drivers attending continue to be paid by their employers. The course is a comprehensive one covering not only technical features of the vehicle and driving, but also the psychological angles involved. In nearly four years of operation this Rieneck driving school has proved successful in turning out good professional drivers who now set an example to other heavy truck drivers and enhance the reputation of the professional driver generally.

Great Britain

The Royal Society for the Prevention of Accidents reports that in Great Britain, while the courts may require a further test before a licence is restored after disqualification, there is no requirement to undergo refresher courses. Some voluntary schemes exist, none of them involving behind-the-wheel tuition. Lectures may range from a course of three to as many as 22 sessions, including both vehicle maintenance and driving technique. Tests and examinations for experienced drivers are conducted by such organizations as the Institute of Advanced Motorists and the Car and Motorcycle Drivers' Association. RoSPA House, London, is equipped with facilities and instructors and has provided intensive instruction annually for some 30,000 road users of all ages and classes including experienced commercial drivers.

India

Mr. V. P. Puri reports that some state undertakings in India conduct courses in the form of lectures for their own drivers.

Norway

In Norway, voluntary classroom courses for drivers are arranged by motoring schools, and advantage of these is frequently taken by persons who are due to renew their five-yearly licences. Moped drivers in Norway do not require driving licenses and the National Road Safety Council is promoting refresher courses to improve their knowledge of traffic rules.

South Africa

Most of the commercial transport undertakings which operate on a large scale have their own driving schools but from the report of the Automobile Association of South Africa it would appear that these are used mainly for the selection and initial training of drivers.

Switzerland

The Touring Club of Switzerland indicates that refresher courses there are instigated by its different sections, and the touring publications also supply information and advice to drivers.

United States of America

A wealth of information is contained in the reports of the American Automobile Association and of Mr. Fletcher N. Platt. Refresher courses in U.S.A. fall mainly into four broad groups. Firstly, there are the general traffic improvement schools for drivers and pedestrians conducted by the police authorities and attended by traffic violators sent by the courts and also by members of the public who may attend voluntarily; secondly, fleet training programmes by transport companies for their own drivers; thirdly, military driver training programmes; and fourthly, traffic instruction as part of the off-job safety programme of industry.

General traffic improvement schools are conducted in more than 200 cities in U.S.A., most being initiated by the courts. Their operation is mainly the responsibility of the police who meet most of the expense and usually provide the equipment and the instructors. However, financial assistance is often given by insurance companies or safety councils, and there is a growing trend towards the use of driver education instructors from the secondary schools. Specialist guest instructors are also availed of sometimes.

The Courts in most States may direct traffic violators to attend these courses instead of, or in addition to a penalty, but voluntary attendance at these schools by the general public has exceeded expectations. The courses vary from one to 18 sessions each of one to two hours. The A.A.A. recommends eight one-hour sessions as being of suitable duration. Classes are usually held once weekly and the subject matter dealt with includes a description of the traffic accident problem, causes of accidents, traffic laws and enforcement, and also the question of driver attitude.

New Zealand

In one of the major cities, weekly classes are conducted by the traffic enforcement department of the municipality. Personal invitations to attend and bring a friend are sent to licence holders selected at random. This results in about 50 per cent acceptance. Occasionally a group such as a motorcycle club is invited and sometimes invitations are sent to certain traffic offenders, but there is no direction to attend although this is being discussed with the magistrates.

Lectures with discussions are sometimes given by selected traffic officers of the Transport Department to local groups such as elderly drivers (who are required to submit to an annual test) or to community organizations, for example, women's clubs, farmers, rotary, or school parent organizations. Sometimes general traffic instructional talks are given at old people's homes and also to factory workers.

Some of the commercial driving schools offer individual refresher instruction including behind-the-wheel tuition and this is availed of to a limited extent.

Views in the reports

The general belief seems to be held that refresher courses in their various forms can undoubtedly be valuable in promoting a better understanding, knowledge and attitude to traffic responsibilities, and that this in turn promotes a higher standard of driving and improved safety on the road.

Dr. Heyse speaks highly of the results achieved in particular by the Rieneck School for Long Distance Drivers and advocates the extension of this type of institution. The good general example on the road of the truck driver who passes through the Rieneck School induces improved traffic discipline in others.

According to the American A.A., the majority of traffic authorities agree that traffic schools are one of the most important factors in any accident prevention programme. Although no statistics are available to establish that driver improvement schools do improve safety records, few students are directed to the schools for a second time and the A.A. suggests that the large voluntary attendances at the courses afford a good measure of their success.

Mr. Platt says: 'Upgrading the millions of experienced drivers by even a small amount will have an appreciable effect on traffic accident records.' In his experience some fleet driver training programmes have reduced accidents by 50 per cent even in fleets with good records.

Usefulness of Refresher Courses

There are four basic qualities that are of importance in a motor driver:

(*a*) his temperament or personality, which largely determines his attitude;
(*b*) his physical qualifications;
(*c*) his skill in handling a vehicle; and
(*d*) his knowledge, not only of the rules and requirements, but also of the principles of safe driving.

In my view refresher courses can do little to influence temperament although they may induce some self-examination and thereby have some effect upon the drivers' attitude. Also, apart from helping to identify certain physical limitations in the individual, as for example, defective vision, the refresher course cannot affect the drivers' physical qualifications.

I do not consider that a driver improvement course should include practical behind-the-wheel instruction. This would entail individual tuition and be too costly in man-hours of instruction to be a practicable proposition on a large scale. Drivers who need to gain skill in handling a vehicle should take steps to obtain this through a commercial driving school. The time and effort which would have to be devoted to improving the skill of a relatively few drivers would return much greater dividends if spent instead in imparting classroom instruction in the responsibilities, rules and principles of driving to groups of 30 to 50 refresher pupils.

Mr. Platt found that 90 per cent of American drivers rated themselves as above average in ability and only two

per cent believed themselves to be poorer drivers than the average. I am sure that a similar survey conducted in most countries would produce results that are comparable. Drivers generally do not realize their own deficiencies. Yet, by their accidents and by the frequency of their faults in driving procedure, many drivers show themselves to be below the desirable standard in at least one of the basic qualities which I have defined as being of importance. It is my belief that in most cases this deficiency lies in the driver's lack of knowledge and in his attitude.

Most violations are not wilful—they occur either through carelessness or through ignorance or through a lack of recognition of the possible dangers involved. I firmly believe that the most effective means of correction even in cases of carelessness lies not in punishment, but in education. Lack of knowledge can be corrected fully by education in driver improvement classes, and a careless attitude can be influenced by a carefully planned presentation of the courses.

Conclusions

(*i*) Education is more widely effective than punishment, and refresher courses for drivers and others are extremely valuable in promoting safety on the road.

(*ii*) Courses should take the form of classroom lectures, discussions and demonstrations.

(*iii*) A driver improvement course should include a description of the traffic accident problem and the causes of accidents, deal with driver attitude and the rules, requirements and principles of driving; and also cover any local problems and matters which do not appear to be generally understood.

(*iv*) The length of a course and the amount of detail to be given depends upon the instructional resources and size of the population which it is hoped to embrace, but its duration should be not less than three sessions each of two hours. It is preferable to shorten the course of this extent rather than to attempt to cover the field in greater detail for lesser numbers of drivers.

(*v*) Behind-the-wheel instruction should not be attempted on a general scale, but those drivers who need to improve their skill in handling a vehicle should take further lessons from commercial driving schools.

(*vi*) General driver improvement courses should cater for both voluntary attenders and also offenders against the traffic laws who are directed by the court to undergo educational training.

(*vii*) Personal invitations to attend a driver improvement course, issued by the traffic authority, are effective in bringing drivers to the classes.

(*viii*) Special courses for their employees arranged by government departments, public bodies, private transport concerns, and by general industrial organizations or groups have proved their value and should be encouraged.

(*ix*) All organizations competent to conduct improvement courses for general drivers should be encouraged to do so, this work being guided and co-ordinated by some responsible public agency.

(*x*) There is a valuable field for one-session courses upon traffic matters for special-interest groups of the general public.

Effect of Speed on Accidents

(*Continued from page* 478)

Mr. Solomon described an interesting attempt made in the United States, to determine the effect of speed as well as speed limits on accidents. Drivers involved in accidents were asked what their speeds were just before the accident and these were compared with measured speeds on the roads on which the accidents occurred. Mr. Solomon's conclusions were:

(i) There was an unmistakable indication that low speed drivers were more likely to be involved in accidents than high speed drivers, but at extremely high speed the difference disappeared.

(ii) Accidents occurring at moderate and high speeds were found to be considerably more severe than accidents which took place at very low speeds.

(iii) The involvement rate was a minimum at a speed which was usually five or 10 mile/h higher than the average speed of the study sections.

(iv) A reduction in the variation in speed amongst drivers could reduce accidents more than a reduction in average speeds.

Dr. Smeed said that the first conclusion that low speed drivers were especially liable to be involved in accidents was plausible and in line with other investigations that had been made. It was known that parked vehicles were especially likely to cause accidents and it might reasonably be expected that very slow moving vehicles would have the same effect. The second conclusion that high speed accidents were considerably more severe than low speed ones was also in line with other investigations. The third conclusion that the chance of an accident was least when driving five or 10 mile/h faster than the average speed for the road was, he thought, unacceptable. Drivers' estimates of their own speeds before an accident might well be more than five or 10 miles lower than their actual speeds and, if this were so, the main bases on which the conclusion was drawn would be upset. This point was not discussed in Mr. Solomon's paper.

There were other reasons for rejecting that conclusion. Even if the accident rate per vehicle mile were found to be lowest at a given speed, it would not follow that this was the safest speed at which to travel. It was certain that there was a strong tendency for drivers to travel faster on safer roads or when driving conditions made for safety. It did not follow that it was fast driving which made for safety. It was much more likely that safe conditions made for fast driving. Thus, the number of accidents per vehicle mile on urban shopping streets was many times that on motorways. The average speed was, however, known to be lowest on shopping streets and highest on motorways. It did not follow that it was safest to drive at motorway speed on a busy shopping street.

Conclusions

Data on the effects of speed limits from a number of countries had been analysed. It was found that:

(i) A high proportion of drivers do not limit their speeds as they should in order to accord with legal requirements.

(ii) In nearly all cases for which there were satisfactory data, a speed limit had a marked effect in reducing the higher speeds.

(iii) In some cases, however, speeds were identical before and after the imposition of the limit. This may have been because of the unsatisfactory nature of the speed limits or of their enforcement. It may have been due to the signs indicating the speed limits. It might also, in some cases, have been due to the measurements of speed.

(iv) Speed limits seem to have a marked effect in reducing fatal accidents in urban areas. They had a lesser effect on slight or damage-only accidents.

(v) There was some evidence that motor cyclist and pedal cyclist fatalities were especially affected by speed limits.

(vi) The imposition of speed limits on a number of stretches of main roads, including a motorway, seemed to have had a favourable effect on road accidents.

Dr. Smeed stated that no attempt had been made in his report to discuss some aspects of the subject. Thus, there could be no doubt that drivers should adjust their speed according to circumstances. A speed limit could not, in practice, be put low enough to make it a suitable speed in bad conditions, such as fog, and, on the other hand, it lost much of the value if the limit were put at a value suitable for especially favourable conditions, such as early in the morning on a good summer day with no pedestrian or other traffic on the road. If the great majority of drivers could be relied upon to adjust their speed properly according to circumstances, argument against the use of speed limits would be very strong. Many people, however, believed that many drivers could not be so relied upon. Some information on the possibility of using other methods for improving driver behaviour would be very useful, and Dr. Smeed suggested that perhaps this subject could be discussed in a future Study Week. There were many other aspects of the subject that might also be usefully considered.

Acknowledgment: This paper is published by permission of the Director of Road Research.

CROWTHORNE RESEARCH TRACK

THE Road Research Laboratory's track at Crowthorne is a three-mile stretch of road in the form of a figure-of-eight, around a central 900-ft. diameter circle of asphalt and stone, carved out of a forestry plantation at a cost of £500,000. It is an admirable piece of road engineering, for the degree of accuracy of its finished surface was very exacting on the Ministry of Works, who, with the Road Research Laboratory, were responsible for the design, and the main contractors, the Turriff Construction Corporation. In fact, on one stretch it had to be precise to $\frac{1}{4}$ in. in 20 feet, in order that the Laboratory could undertake with the assurance of accuracy the controlled experiments which it conducts.

The track was described in the July 1960 issue of *Traffic Engineering & Control* and some indication was then given of the research work which would be facilitated by the provision of this modern track. Recently, however, the track was thrown open for inspection, and more details of its actual construction became available and demonstrations were given of the work now being carried out there.

The main objectives in designing the track were outlined by Sir William Glanville, Director of Road Research, as:

(1) to provide large flat areas with suitable approach roads to enable the stability of vehicles performing manoeuvres involving steering, braking and accelerating at normal road speeds to be investigated.

(2) to provide facilities for studying the skidding properties of wet surfaces, in particular the material and texture used for the surfaces, the effect of the properties of the tyre and the type of vehicle, its speed and braking system.

(3) to enable vehicle lighting tests to be carried out on straight and curved roads with surfaces of various types and colours.

(4) to enable crash-injury research to be conducted under appropriate conditions.

(5) to enable comparisons of street lighting systems to be made under controlled conditions.

(6) to provide a continuous circuit round which vehicles can be driven while the actions and reactions of their drivers are studied.

(7) to provide facilities for traffic tests of intersection layouts, traffic signals, road signs, safety barriers and other aids to traffic flow.

(8) to provide facilities for the study of vehicle guidance and the many other matters with which the Laboratory is concerned.

The most spectacular of the demonstrations were those of investigations into the skid-resisting properties of roads and tyres and vehicle behaviour both at speed and in normal conditions. One device developed to assist in making such tests is the fitting of a vehicle with an extra wheel, so arranged that it slides sideways while the car is moving forward normally. This apparatus produces a continuous record of skidding resistance on a moving paper chart and carries its own built-in road watering system for testing on public roads. It is possible to test lengths of up to two miles of road with this machine.

Another simpler method the Laboratory has developed for keeping a check on the skidding resistance of roads, and which should be of assistance to highway engineers and local authorities, is a decelerometer of a simple type. It is mounted in a car or van which is then driven over the wetted test surface at the desired speed, usually 30 mile/h. The brakes are applied so as to lock all four wheels for one second. The decelerometer provides a direct reading of the skidding resistance of the test surface. This method is used by the Laboratory to study the performance of different type tread patterns and materials.

For measurements of skidding resistance at high speeds the Laboratory has developed a small braking-force trailer which is towed by a car capable of making measurements at speeds of over 100 mile/h. With the towing vehicle travelling at the desired speed the trailer wheel is locked for two to three seconds and a record of the force between the tyre and the road surface is obtained on a moving paper chart. This apparatus is used on motorways and other roads of that type and also on airfield runways where slipperiness can also be a serious problem in wet weather.

Another simple device which can be used by highway engineers is the Portable Skid Resistance Tester developed by the Road Research Laboratory. In this a rubber slider is mounted on the end of a pendulum arm which is made to swing across the wetted road surface. The frictional resistance between this slider and the road is indicated by a pointer on a calibrated scale. Over 90 of these Testers are now in use in this country and abroad, and are being manufactured by three concerns.

Interesting studies are being made of driver behaviour. Heretofore, it has been found difficult to study the interaction between drivers, for example when one vehicle follows another. In the system demonstrated, information from two moving vehicles, one following another, was conveyed by radio to a fixed receiving station. The distance travelled by each vehicle, the speed, the throttle position and the amount of braking were recorded for both vehicles on the same chart. The experiment in progress is one to determine safe following distances.

Methods of detecting traffic density have previously been developed to a greater extent in the United States than in this country. The Laboratory is, however, conducting experiments in this field, since it is concerned with investigating methods of improving flow on crowded roads by detecting

(*Concluded on page* 485)

4. SPEED STUDIES

By F. D. HOBBS

Paviors Lecturer in Highway and Traffic Engineering

LAST month's article dealt with some aspects of speed analysis and one of the important measures of dispersion is the standard deviation an example of which is illustrated below:

S.D. of a grouped frequency distribution

$$s = \sqrt{\frac{\text{Sum of frequencies x deviations squared}}{\text{Sum of frequencies}}}$$

$$s = \sqrt{\frac{\Sigma fd,^2}{\Sigma f}}$$

where:

s = standard deviation.
f = frequency.
d = deviation from true mean.

A method of obtaining the standard deviation from an assumed mean with the deviations expressed in group intervals is shown below.

Here
$$s = \sqrt{\frac{\Sigma fd_1^2}{N} - \left(\frac{\Sigma fd_1}{N}\right)^2} \times i$$

$$(\Sigma f = N)$$

In this case d_1 denotes the deviation from the assumed mean and i is the group interval.

A further measure for comparison purposes is known as the coefficient of variation. It is defined as the ratio of the s.d. to the mean expressed as a percentage.

$$V = \frac{100s}{\bar{x}}$$

where:

V = coefficient of variation.
$\bar{x}$ = mean value.

A high value indicates wide scatter about the mean and *vice versa*, although, if the series being compared are expressed in similar units of measurement and the means are similar, calculation of the standard deviation is sufficient. (See Fig. 5.)

(*a*) *Standard Deviation.*

$$s = \sqrt{\frac{556}{187} - \left(\frac{-38}{187}\right)^2} \times 5$$

$$s = 8.56 \text{ m.p.h.}$$

(*b*) *Mean speed* $\bar{x} = 42.5 + \left(\frac{-38}{187}\right) \times 5$

$$= 41.48 \text{ m.p.h.}$$

(*c*) *Coefficient of Variation*

$$V = \frac{8.56 \times 100}{41.48}$$

$$V = 20.6\%$$

Spot speed characteristics are of primary importance to traffic engineering study and are used for a variety of purposes. The upper and lower portions of the cumulative frequency curve from important limits. For speed limits and double white line markings drivers exceeding the 85th percentile speed are usually considered to be driving faster than is safe under the prevailing conditions. If no guidance is given by speed limits on a certain length of road, investigation tends to show that the imposition of a limit at about the 85th percentile will lower the mean speed and at the same time reduce the number of accidents. More care is required with the raising of limits above the existing 30 m.p.h. as general roadway conditions must also be taken into account. With higher speeds drivers require greater thinking time and their observation becomes more concentrated on the task of driving, besides which there is the inevitable increase in stopping distances. However, in general, where dual carriageways are present, pedestrian control is adequate and lighting standards good, then the economic and enforcement benefits to be derived justify the use of the 85th percentile to a raising of speed limits which should be accompanied without an increase in the accident rate. Better conditions of enforcement are an essential factor not to be ignored. The use of double white lines again makes use of the 85th percentile speed as a more reasonable approach to enforcement. Visibility can be taken into account for each direction of travel, the decision where not to overtake is shown definitely by the full line. On the broken line sections, overtaking is allowed and the driver can take the necessary decision according to the circumstances. The few offenders can be dealt with by the law.

For any sampling distribution the mean and standard deviation can be calculated. The standard deviation of the sampling distribution is known as the standard error.

$$\text{s.e.} = \frac{s}{\sqrt{n}}$$

Where s.e. is the standard error of the mean of the sample.

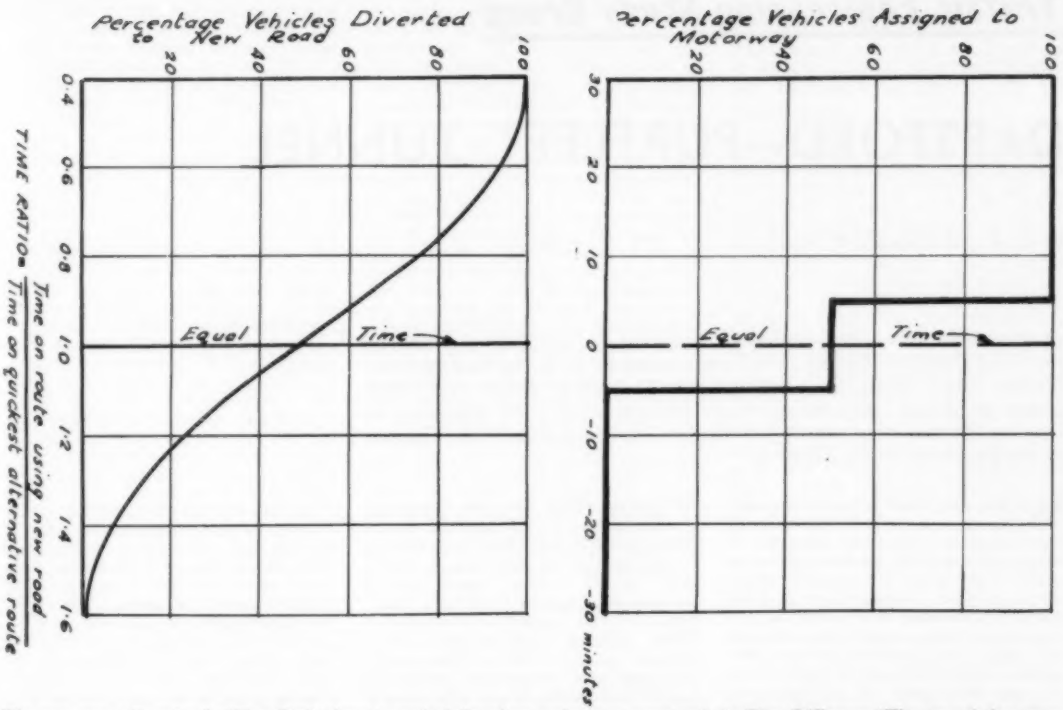
s = standard deviation calculated from the sample.

n = total number of observations in sample.

It will be noted that in order to halve the standard error of the mean the size of the sample must be increased by four.

Spot speeds Rural 'A' Route

Classes m.p.h.	Mid Pt.	Frequency f	Deviation d_1	fxd_1	$fd_1 \times d_1 = fd_1^2$
20 — 24.9	22.5	4	−4	−16	64
25 — 29.9	27.5	8	−3	−24	72
30 — 34.9	32.5	34	−2	−68	136
35 — 39.9	37.5	40	−1	−40	40
40 — 44.9	42.5	36	0	0	0
45 — 49.9	47.5	36	1	36	36
50 — 54.9	52.5	18	2	36	72
55 — 59.9	57.5	7	3	21	63
60 — 64.9	62.5	3	4	12	48
65 — 69.9	67.5	1	5	5	25
		187		−148	
				+110	556
Totals:				−38	



The percentage diversion by Time Ratio shows a typical American assignment curve and the Time Difference (Time on existing route minus time on route using motorway.) shows the assignment curve used for the London-Birmingham Motorway (The London-Birmingham Motorway, Traffic and Economics, Road Research Technical Paper No. 46. H.M.S.O.).

In the example shown we find that:

$$\text{s.e.} = \frac{s}{\sqrt{n}}$$

$$= \frac{8.56}{\sqrt{187}} = \frac{8.56}{13.7} = 0.62 \text{ m.p.h.}$$

Hence, by making use of the properties of the normal curve, it can be shown that approximately 95 per cent of the sample means will be within $\pm$ two standard deviations (1.96 actual) from the mean of the sampling distribution and it can be inferred that the population mean lies within a range of 41.48 m.p.h. + or — 0.62 x 2 = 1.24 m.p.h. at the 5 per cent level. A definite limit of confidence is placed on the information and the chances of it deviating more than the value shown are, in this case, only five in 100. Suppose that a closer prediction is required at this level of confidence e.g. that the standard error should be 0.25 m.p.h. then the sample size required will be:

$$0.25 = \frac{8.56}{\sqrt{x}}$$

number of observations required,

$$x = 1172$$

Studies carried out, particularly in the United States have shown the effects of increasing volume on the speed distribution curves. At the maximum capacity of a road under its prevailing conditions (possible capacity), the mean difference in speed between successive vehicles is zero. Throughout an increasing volume range the mean difference in speeds, and the mean speed of traffic, is said to show a linear relationship declining with increased volume. By measuring speeds of all vehicles at, say, three selected levels of volume then the interpolation of a possible capacity can be found from the data. (Highway Capacity Manual—U.S. Department of Commerce, Bureau of Public Roads, Washington. 1950).

Where new roads or major improvements to existing highways are being carried out, some method of estimating the amount of traffic deviating to the new, or increased use of the improved routes is required. These investigations, known generally as traffic assignment, are particularly important if the best use is to be made of limited capital available and economic design is to be achieved. The factors affecting assignment include distance and time ratios, differences in distance and time, and type of facility and connections. It has been found generally that time provides the best estimate and the figures show typical traffic assignment curves by time ratio and time difference. The method of compilation of the curves is largely based on origin and destination studies of existing routes for alternative journeys with the journey time measurements previously mentioned. For new roads, estimates of journey time can be accurately assessed from speed studies for routes of a similar type. Average time savings can then be computed for primary origins and final destinations together with intermediate journeys. For economic benefits to be derived, it is necessary to obtain other information on such items as vehicle operation, drivers' time, fuel consumption etc. Some of these factors will be taken into account in the next months' article.

Crowthorne Track *continued from page* 483

traffic congestion and taking control measures to reduce it. A comparatively simple method, used in the United States, is to insert a loop of wire in the carriageway, which, because cars of are steel manufacture, will detect their presence when above the loop. By laying two loops of wire in the roadway, the speed of the car can be measured. The Laboratory is now investigating the loop detector and also working on a new British congestion detector which uses a minute crystal to measure the magnetic effect of passing cars. A demonstration showed how this device could be applied to prevent congestion at roundabouts by conveying information as to the excessive volume of traffic to traffic lights and causing them to operate.

Of less immediate practicability is the shortest route computer which was also demonstrated. This calculates the shortest route through a road network and where, by the use of density detectors, congestion is reported, in conjunction with the use of variable direction signs, traffic could be routed away from roads which were temporarily blocked.

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DARTFORD—PURFLEET TUNNEL

by F. A. RAYFIELD, M.I.C.E.

A discussion on a traffic survey conducted in conjunction with the projected Dartford-Purfleet tunnel was opened by F. A. Rayfield, M.I.C.E., Deputy Chief Engineer, London County Council, before the Study Group on Traffic Engineering of the Insititution of Civil Engineers on October 27. His introductory remarks are printed with a brief summary of the discussion which followed.

WORK on the tunnel was suspended during and after World War II and the survey was made in order to support the case for the resumption of work. The tunnel is situated lower down the River Thames than any other road traffic crossing except the Tilbury/Gravesend Ferries and it was desired to make an estimate of the probable extent to which it would be used. It was obvious that most of the potential traffic, apart from natural increase, was already making use of the existing cross-river facilities, probably being concentrated on the more easterly of them, and that they were therefore the most suitable places at which to take counts. With one exception (Gravesend/Tilbury Ferry) these facilities lay within the County of London and the Chief Engineer, London County Council, was accordingly asked to organize and conduct the survey. It was also clear that the manpower resources available were not adequate to make surveys at each crossing and six only were chosen. These comprised all the crossings from the ferry mentioned to Tower Bridge (inclusive) and Vauxhall Bridge in the West as a check point. There were thus two ferries, two tunnels and two bridges.

The two purposes of the survey were (a) to find out whence drivers at each crossing had come and where they were going, and (b) because (a) would have to be done on a 20 per cent sample basis (except at the ferries), to make a volumetric count at each crossing. As private car traffic was likely to be an important factor in the new tunnel at week-ends, the survey was made on a Sunday and the most typical week-day, Tuesday. The Sunday survey was made first so that the experience gained could minimize delays to traffic on the economically more important week-day. The Sunday survey was for 14 hours (8 a.m.-10 p.m.) and the Tuesday survey for 12 hours (7 a.m.-7 p.m.). Traffic in one direction only was surveyed and, with the exception of Tower Bridge for layout reasons, the more convenient direction was Southbound. A press notice was issued by the Metropolitan Police; this stated the purpose of the survey and requested the co-operation of the public but did not give the dates. This was considered of importance, in that normal movements would be less likely to be altered.

The layouts at the census points were closely similar. First was a prominent advanced warning sign; next, 250 feet farther on, a series of Police 'winker' markers and longitudinal barriers which reduced traffic to a single lane for counting. At the end a policeman diverted every fifth vehicle, except for certain classes, into the questioning lane, the remaining vehicles passing through a second lane without stopping. A second policeman stopped the vehicles whose drivers were to be questioned. Drivers at the ferries were questioned while waiting to embark in one case and on the vessels in the other.

London Transport buses and Green Line coaches, fire appliances, ambulances, taxis, military and other service vehicles, horsed vehicles, pedal cyclists and barrows were not stopped. These were not counted by the first policeman but taxis and pedal cycles were counted by the enumerator.

The questioner showed his question card 'Where have you come from'? ('Where was your last call?') and 'Where are you going?' ('Where is your next call?') to the driver of each stopped vehicle, repeated the questions verbally if necessary, and recorded the answers. The importance of a pleasant manner, coupled with confidence that reasonable replies would be received, and the necessity for increased accuracy and definition as the crossing places approached the new tunnel site were stressed. A team of questioners comprised three persons who relieved each other at half hourly intervals and were on duty continuously for six to seven hours. Vehicles were divided into five classes and a different code letter used for each.

Briefing and a short rehearsal took place at one point two days before the first survey day. This was useful, and a few minor supplementary instructions were issued to underline some factors already covered, and to incorporate the lessons learned. Before the week-day survey, a final set of instructions was issued to provide, if necessary, for avoidance of inordinate delay in the rush hour period by reducing the sample rate from 20 per cent to 10 per cent.

In the analysis the totalling of the volume by groups involved no special features but the process of estimating the probable user of the new tunnel was much more complicated and involved special treatment because, unlike any of the crossings except the eastern ferry, vehicles using the tunnel would have to pay tolls. It will be appreciated that even with only 96 sectors taken as origins and destinations there were 962 or over 9,000 possible journeys for each census point.

The first stage of this assessment consisted in a geographical codification of journey origins and destination. For all crossings except the eastern ferry these points were plotted on maps of suitable scales and transparent overlays with a circular sector diagram were placed successively with the centre at each crossing. (Fig. 2). Then the points were converted into a letter/number

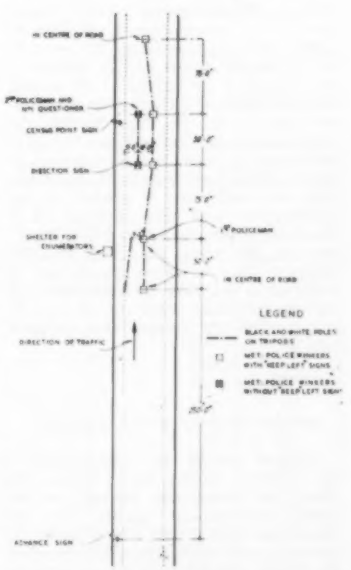


Fig. 1. Positioning on carriageway and location of personnel for intercepting vehicles and interviewing drivers.

code for the two main classes of vehicle, private and commercial, and entered on a class diagram for each crossing, the totals being inserted in each cross referenced space at the end of the operation. At the eastern ferry only the western half of the sector diagrams were used because there was no other crossing to the East and details were unnecessary for the eastern half.

The next stage was to assess those journeys on which it would pay a driver to use the new tunnel. To reduce the large volume of work involved, without significantly affecting the accuracy of the results, certain simplifications and assumptions were made. For instance, although different drivers on identical journeys would, no doubt, not invariably follow the tunnel route, it was assumed that if the average driver was likely to use it, all drivers would also use it. To simplify the measurement of distances, origins and destinations were assumed to be in the centre of their respective sectors where both were within 20 miles radius of the survey point. The tunnel tolls had not at this date been fixed and were therefore first assumed to be twice those of the 1937 Act. Later, a flat rate irrespective of vehicle classification was adopted. Unit costs per mile of distance and minute of running time were assumed for each main class of vehicle. Running time was based on various point to point assumed speeds, ranging from 10 m.p.h. for commercial vehicles on a week-day in inner London to 24 m.p.h. for private vehicles outside the County of London and contiguous county boroughs. Waiting time at the ferries was also assumed to be of certain fixed periods, ranging from 40 minutes to one hour.

From inspection of the journey diagrams a considerable proportion of journeys could be assessed without calculation as either potential tunnel users or non-tunnel users, and the appropriate journey spaces on the diagrams were then coloured red or blue respectively. For the remainder, calculation was necessary and the most convenient common measure to which all major elements could be reduced was a monetary one. For each such journey two calculations were necessary; one arriving at the cost by the route actually followed and the other at the cost by the tunnel route. The space on the diagram would then be coloured red or blue according to which calculation gave the lower figure. Because of the large amount of work required in making these calculations, it is possible, where a quick but approximate result is required or would be adequate, to strike an average on the diagram and to reach approximate totals by this means.

The results so obtained from the samples were then equated to actual volumes, totalled from all the crossings, and the totals doubled to allow for traffic in both directions. A small additional proportion of traffic at the other river crossings not surveyed was added, but no allowance was made for new traffic generated by the additional crossing facility.

The conclusion reached was that, on the volumes surveyed, some 6,400 vehicles (3,700 private and 2,700 commercial) would probably use the new tunnel every 16-hour working day.

This survey was probably the most extensive undertaken in this country up to this time and its method was largely devised by Mr. A. J. H. Clayton, A.M.I.C.E., of the Chief Engineer's Department, L.C.C. No details are available as to its cost. It would have been impracticable without the ready co-operation of the County Surveyors of Essex and Kent, the Metropolitan and County Police, the Metropolitan Boroughs concerned, the motoring organizations and the L.C.C. jobbing works contractor at that time, Messrs. John Mowlem & Co. Ltd.

1960 Survey

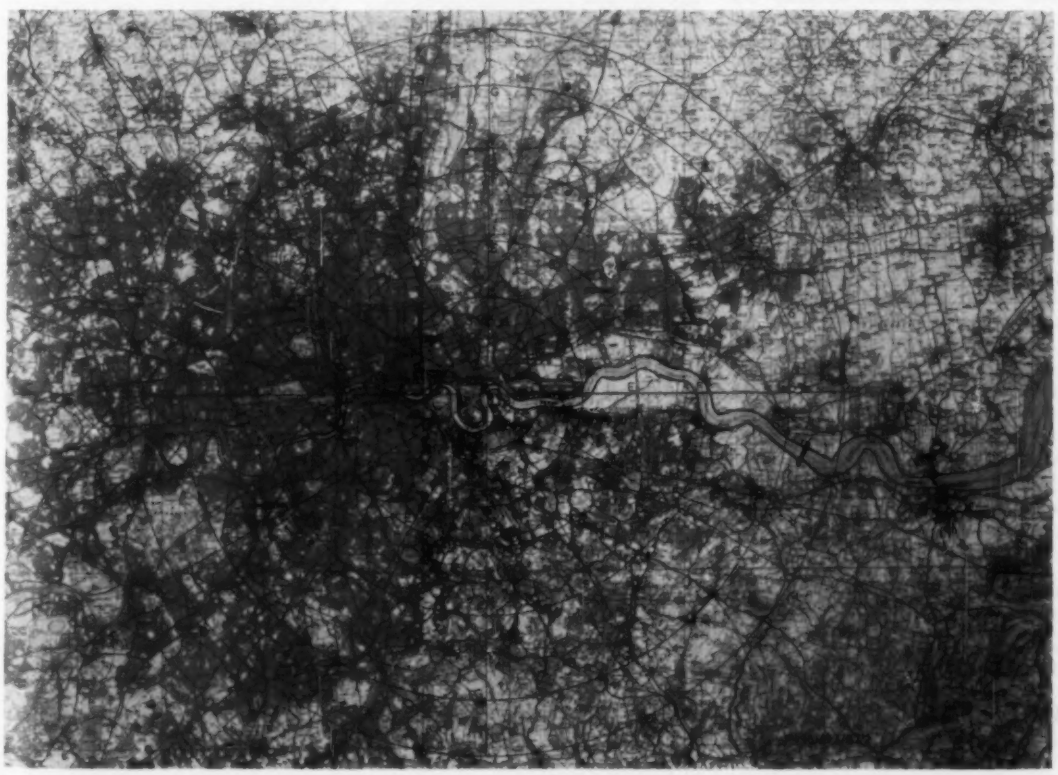
A contributor to the discussion said that Mr. Rayfield had given a clear and concise account of the survey conducted in 1953 to support the case for the resumption of work on the Dartford-Purfleet Tunnel. That decision having been taken, it had become necessary to fix the level of the tolls to be charged when the tunnel was opened and the amount of revenue which could be expected from them. In view of the importance of making a reasonably accurate assessment of the revenue, it had been decided that the survey should be repeated this year. This second survey had been carried out by the Kent and Essex Councils in May on a Sunday and a Monday. The field work had followed very closely the pattern set by the L.C.C. in 1953, and the great thoroughness with which the earlier survey had been organized, and the precise written instructions laid down for carrying out that survey had made the work of the second survey comparatively simple.

The survey had been taken for 14 hours on the Sunday and 12 hours on the week-day, but they had taken the Southbound traffic on every crossing from Tilbury to Tower Bridge. No check had been made at Vauxhall Bridge. In place of the fixed 20 per cent sample used in 1953, the sampling

Only one man had been used for questioning at each crossing at any given time. As soon as he had finished interviewing one vehicle driver, he

(*Concluded on page* 489)

Fig. 2. An example of how the sector overlay was centred on river crossings to help plot origins and destinations.



Chicago— RUSH HOUR CONTROLS

IN the United States many cities impose additional parking restrictions on streets leading to the central business district during the peak periods, both morning and evening. Times and durations vary according to the distance from the city centre, often starting on the periphery at 7 a.m. and ending at 9 a.m., while closer to and within the centre they may be half an hour or more later. During the evening rush hour the additional restrictions generally operate from 4 p.m. to 6 p.m., and possibly later on the outskirts. Signs giving the times of the restrictions, together with those which may apply during the rest of the day, are placed at frequent intervals, often on every lamp post.

Following a comprehensive survey and analysis of traffic flow and street capacity, Chicago recently decided to add to the 291 street kerb miles on which such restrictions were already imposed another 160 miles and these new restrictions have now been introduced. In presenting the report making these recommendations, the Bureau of Street Traffic in co-operation with the Chicago Transit Authority made the case for so extending the controls as follows:

At the present time there are 291 kerb miles of rush hour parking controls in effect within the City. These controls cover sections of important major streets and boulevards where traffic demand could not be accommodated if parking during rush periods was permitted. The growth in vehicular usage requires a constant upgrading of the service provided by our major street system. Providing an additional traffic lane during the more critical periods of the day is an important method for providing this increased service.

Experience shows that when rush hour parking controls are imposed on major traffic carrying streets efficiency in traffic movement increases materially. Studies show that traffic volumes have increased from 20 per cent to over 50 per cent, with a corresponding increase in speed of from 25 per cent to 35 per cent. These improvements have greatly reduced rush period congestion and delays.

The Bureau of Street Traffic made studies of representative shopping districts throughout the city to determine the kerb parking demand in these centres between the hours of 4 p.m. and 6 p.m. These studies showed that this demand varied from a low of 0.5 vehicles per retail establishment to a high of 2.0 vehicles. The city-wide average kerb parking demand, during the evening two hour rush period of 4 p.m. to 6 p.m., was 1.1 vehicles per store.

This report recommends the imposing of rush hour parking controls on 160 additional kerb miles of streets. Streets included in this recommended addition are at least as equally important as those now controlled by such parking restrictions and are all operating at levels of traffic congestion that seriously delay many hundreds of people.

The three major criteria used as a basis for establishing the additional rush hour parking controls are:

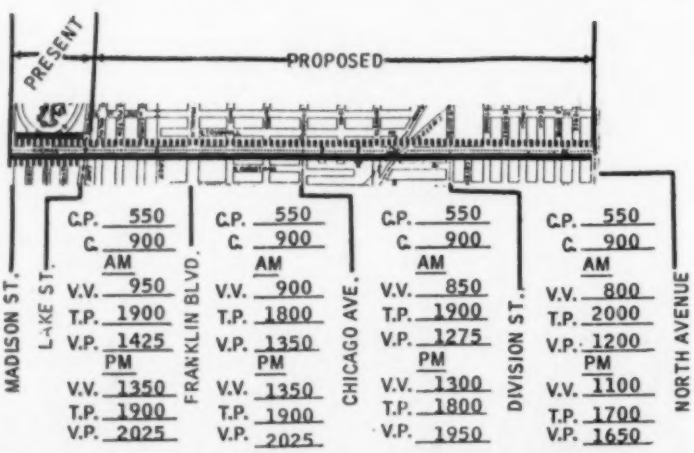


Fig. 1. Chart showing present and proposed parking prohibition with traffic volume and number of passengers, Homan Avenue, key to which is at end of article.

1. In order for a street section to be considered for rush hour parking controls the total number of mass transit passengers travelling along the street section, in one direction, must be 800 or more for the two hour rush period.

2. The width of a street section, with cars parked at the kerb, must be too narrow to accommodate the number of vehicles attempting to move through the section and an unreasonable amount of delay is created.

3. On streets with a width of 56 feet or more (capable of accommodating two moving traffic lanes and a parking lane in each direction) the recommendation is to prohibit parking for a distance of 200 feet on both the entrance and exit sides of signalized intersections. On streets less than 56 feet wide (streets not capable of accommodating two moving traffic lanes and a parking lane in each direction) it is recommended that the rush hour parking controls be continuous.

It will be noted that, under these criteria, no sections of streets are included where, although vehicular volumes and street capacity with parking justifies imposition of rush hour parking controls, transit passenger volumes are below 800 in the peak period. In cases where traffic and transit data show justification for prohibiting parking on the same side of the street during both morning and evening rush periods it is recommended that only the most critical period and direction be controlled. In this manner parking will be prohibited on only one side of a street during any rush period. It should be noted that presently posted restrictions are not affected by these additions as other important criteria were met at the time they were installed.

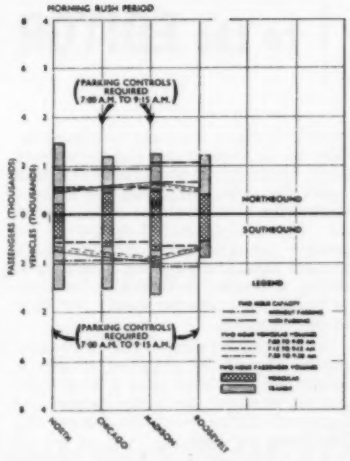


Fig. 2. Traffic flow and capacity and passenger volumes on a section of Homan Avenue morning rush period.

While the removal of parking from one of the kerbs will not, in some cases, provide the needed capacity to accommodate all vehicles travelling in the major direction of travel, it is possible to double capacity on streets that have only one moving lane and the removal of parking creates another.

The great cost of new traffic facilities makes it imperative that present streets be used to their maximum efficiency.

After listing the recommended additional rush hour parking prohibitions, the report publishes tables and charts for each affected street giving in detail the present and proposed rush hour parking controls, together with figures of the street's capacity both with and without the prohibition, the volume of traffic, the number of passengers using public transport (buses) and the total number of passengers in both public and private transport. Examples of the charts of present and proposed rush hour parking controls, and of the basic analysis of traffic flow and street capacity are given in figures 1 and 2 to illustrate the detailed investigation undertaken before the additional controls were recommended and imposed.

Key to Fig. 1: *C.P. capacity with parking. C. capacity with no parking. V.V. total traffic volume. T.P. public transport passengers. V.P. private transport passengers. Broken line a.m. parking control, solid line p.m. parking control.*

Dartford—Purfleet Tunnel, *concluded from page* 487

made a signal to the policeman on duty, whose instructions were to pull in the next vehicle which crossed a certain sampling line laid down on the carriageway. The questioning therefore involved virtually the same number of vehicles per hour, irrespective of the traffic flow, and the interviewer was neither underloaded nor overloaded. The fractions interviewed varied between one in three at Rotherhithe Tunnel on Sunday and one in fifteen at Tower Bridge on Monday.

The zoning had been done somewhat differently than in 1953. Basically, the area on each side of the crossing had been divided by radial lines and concentric circles, but without complete symmetry. As far as possible, each sector had been made homogeneous as a unit for traffic. The analysis of results according to origin and destination had been carried out on punched card machines, and although this had not been completed, some interesting comparisons were possible.

In the 1960 survey, 55,000 vehicles passed in both directions over the five crossings in 12 hours during the survey on the Monday. This was about 50 per cent more than the volume in the 1953 survey at the same five crossings. The increase in the number of private vehicles had been 88 per cent, but the increase in the number of commercial vehicles had been only 24 per cent. The increase of 50 per cent in seven years represented a rate of growth of about 5½ per cent per annum compound on the five crossings for all vehicles. The rate of growth for private vehicles in those seven years was about 9½ per cent compound.

Various crossings had different rates of increase. For example, the week-day private traffic through Blackwall and Rotherhithe Tunnels and over Tower Bridge was about double the 1953 flow. Woolwich Ferry, on the other hand, had only a small increase in private traffic and a decrease in commercial traffic. The Sunday traffic had varied even more widely, from nearly four times the previous flow for private traffic through Rotherhithe to a 30 per cent decrease in both private and commercial traffic using Tilbury Ferry on the Sunday. On weekdays the commercial traffic on these five crossings was now only slightly more than the private traffic, whereas in 1953 the commercial traffic had been about two-thirds greater than the private traffic. On Sunday, the private traffic comprised about 90 per cent of the total.

Preliminary estimates suggested that about half the capacity of the tunnel was likely to be taken up by traffic diverted from other crossings.

ORIGIN AND DESTINATION SURVEY ANALYSIS OF JOURNEYS—1953

Typical Calculations

A vehicle in the Commercial Vehicle Group travelling on a weekday from point A to point B and crossing the Thames at Vauxhall Bridge:—

	£ s. d.
(a) **Evaluation of existing route**	
Distance = 42 plus 14 miles = 56 miles at 6d	1 8 0
Running time:	
Inner London:	
5 miles at 10 m.p.h. = 30 mins.	
Rest of County & Country Boroughs 9 miles at 15 m.p.h. = 36 mins.	
Elsewhere 42 miles at 20 m.p.h. = 126 mins.	
192 at 2d	1 12 0
Waiting time at Ferries—Nil ...	— — —
Tolls —Nil ...	— — —
	3 0 0
(b) **Evaluation of tunnel route**	
Distance = 23 plus 30 miles = 53 miles at 6d.	1 6 6
Running time:	
Inner London = Nil	
Rest of County & County Boroughs = Nil	
Elsewhere = 53 miles at 20 m.p.h. = 159 mins at 2d ...	1 6 6
Waiting time at Ferries—Nil ...	— — —
Tunnel toll	4 0
	2 17 0

Conclusion:
It would be slightly cheaper to use the tunnel route than the Vauxhall Bridge route.

Rates used in Evaluating and Comparing alternative river crossings

Element	*Unit*	*Private Vehicle Group*	*Commercial Vehicle Group*
		s. d.	s. d.
(a) Distance	Mile	3	6
(b) Running Time	Minute	1	2
(c) Waiting time at Ferries	Minute	2	4
(d) Tolls			
(i) **Tilbury-Gravesend Ferry**			
Weekday	Vehicle	6 7	8 9
Sunday	Vehicle	6 7	20 0
(ii) **Dartford-Purfleet Tunnel**			
Weekday	Vehicle	4 0	4 0
Sunday	Vehicle	4 0	15 0

(N.B. Tunnel tolls have been taken as twice those of the 1937 Act to allow for increased costs of construction and maintenance.)

LETTERS to the EDITOR

PARKING IN CITIES

From Major R. A. B. Smith

Out of the varied suggestions promulgated as to the best method of dealing with the complicated question of traffic flow and parking, it is impossible to find any one that can be said to be a true solution of the problem. It may be, however, possible to extract much useful thought as a result of which a plan can be produced which has reasonable possibilities.

Some hold that off-street parking must be found in the centre of cities for long-term parkers, but land is most expensive there, as is the cost of construction. The parker must, therefore, pay what appears to many as an extortionate sum for parking. Further, the rush of traffic in the morning to a large garage and out in the evening must lead to congestion of traffic in the vicinity.

If long-term garages are available in the centre, more and more cars will come there just at the time when congestion is most difficult to avoid. This does not, therefore, seem a very attractive idea.

There are also those who say that parking in streets by short-term parkers should be more and more restricted, so as to allow of a freer flow of traffic; this means that the central garages must be large enough or numerous enough to cater for their needs.

Which is the more important—the long or the short-term parker? The long-term parker works all day in his office or shop, the short-term makes business calls or buys goods. The latter are essential to the former; if they cannot park, those who can will seek business or goods in a more favourable area, and, in consequence, a number of the former will become redundant or their company will be forced to move to some outer area. This, of course, will have two unfortunate results: decline in property and rateable values, whilst it will no longer be easy to have a quick personal discussion with another executive, as distance will rule this out. So we must conclude that the customer or client must be considered before the office or shop worker.

Can we have garage capacity in the centre for both parties? Offices and shops are more essential to the community than motor cars—indeed, without the former there would be no great need for the latter, hence priority must be given to the first, and this leaves little or no land available for garages, and, when it is, it may be unsuitable owing to street widths, etc.

If this is logical then we are inevitably led to the conclusion that garages should be built primarily for the use of short-term parkers, the long-term should only be allowed the use of a gradually diminishing space as the demand for short-term parking increases.

What, then, is the long-term parker to do? He has every right to consideration, as he owns a car and pays taxes for it. Ignoring the small space available under the newer large buildings, there are hundreds of motorists to be catered for. The answer would appear to be garages on the inner fringe. Such garages would be on cheaper land and, owing to better accessibility, cheaper to build: the customer would not have to pay so much.

At the central garages the short-term parker should be required to pay a lower rate per hour than a long-term parker, whilst at the fringe garages the long-term parker would be charged the lower rate per hour.

The siting of fringe garages should be such that either underground travel is adjacent to them, or there is a covered way from garage to bus stop and taxi-rank if the buses do not actually enter the garages.

As these garages become available, more and more streets should be restricted to very limited parking, the majority to no-waiting, and others to rarely more than half-an-hour. Indeed, in some streets the parking meters could be removed as increased traffic flow demands increased space.

Further, as the whole subject is so debateable at the present time, it is desirable that in London in particular, a definite plan should be laid down showing the anticipated garage sites, the principles on which action will be taken, and immediate steps taken to acquire the land and build the garages.

Apart from the parking problem in cities, there is also one for market towns and others of fair sized populations, which calls for a different solution.

The advantage that towns have over cities is that land is not so expensive and therefore the built-up garage is rarely necessary and open spaces are either available or easily made available at a comparatively low cost.

It is essential that the park should be contiguous to the shopping area and should be provided with such amenities as telephone boxes and toilets.

The vehicle access need not necessarily be available from the shopping centre, but it should preferably be from some adjacent street or on one of the approach roads to the town. There should, however, be pedestrian walks directly from the park to the shopping street, the number depending on the size of the park. Unless protection against theft requires the employment of an attendant, no charge should be made. The advantages are two-fold: first, it is desirable that shop and office staffs should not leave their cars in the streets, and second, it is desirable to attract in every way residents to the area to shop locally, which they will be less inclined to do if they find parking difficult.

Ordinary street parking should, as far as possible, be reserved for customers and clients, the loading and unloading of goods at certain intervals of space and a possible bus stop on either side.

Finally, unless more action is taken, authorities will find their rateable values declining alarmingly, and there will be less customers and less clients, who will go to the towns which offer the best facilities.

Road Accidents and B.S.S. 812

From H. N. JENNER, M.B.E., M.I.C.E., M.I.Mun.E., F.Inst.H.E. County Surveyor, Hampshire

Apart from the publications of the Road Research Laboratory on the subject of skidding and its remedies, I think that the revised British Standard No. 812, 1960 on the 'Methods of Sampling and Testing Mineral Aggregates, Sands and Fillers' wants extra publicity at this time because this specification now includes for the first time a test to determine the polishing of stone under traffic.

About a sixth of all accidents are skidding accidents and even omitting realignment and superelevation which may be necessary these accidents can be reduced by 70 per cent to 90 per cent by the use of a better stone either in the surfacing or as surface dressing. From the results obtained in Hampshire there would seem to me to be a moral obligation on Highway Engineers and Highway Authorities to treat in this way skidding accident sites and test road surfaces at potential skidding sites and sites where there may be emergency braking, as at the approaches to roundabouts, pedestrian crossings, traffic lights, etc.

By this means wet skidding accidents at tested sites in Hampshire have been reduced during the past 2½ years from 270 to 36 (including 10 fatalities reduced to 0).

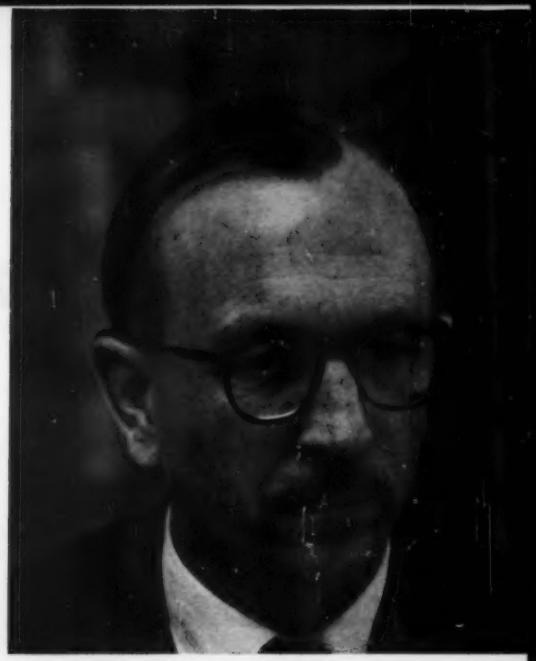
The method of application of the new test in Hampshire has been to ask stone suppliers to state in their tenders the polished stone value of their stone when tendering. This has been checked in the County Laboratory on the method set out in the new British Standard 812. This value has been taken into account with the other properties of the stone and indeed also the price, and stones have been selected in Hampshire which are .60 or slightly under for most skidding sites, but for difficult sites (sharp curvature, steep gradients and hard braking) stones with values above .60 have been chosen.

From my experience as Chairman of the British Standards Specification Committee concerned with this specification and in Hampshire, and with regard to the availability of stone and the test in practice I would not advise that the minimum polished stone value should be called for in a specification, for the simple reason that to quote precise value of, say, .63 might rule out stones of, say, .61 or .62 which the results do not justify.

PROFILE . . .

of a

TRAFFIC ENGINEER



Dr. George Charlesworth

TRAFFIC WARDENS and on-the-spot fines have stolen the picture with the public from the Road Traffic and Road Improvements Act 1960. Traffic engineers will know, however, that a major provision of the measure is the granting of several new powers to enable the Minister of Transport to act more effectively in the amelioration of London's traffic problems. They will also know that, as far back as last February, the Minister announced the setting up of the London Traffic Management Unit to help carry this out. The task of the head of the unit can be described with stark simplicity: to keep London's traffic flowing.

What is he like, Dr. George Charlesworth, seconded to the post from the Road Research Laboratory? A first impression—possibly coloured by knowing his reputation in research—is that here is a scholar who has somehow strayed behind an office desk. However when he begins to talk, in a quiet voice but with assured flow and precision, the suggestion changes to one of an industrial executive who is paying a great deal more than lip service to dynamic new techniques. Perhaps, two of the strongest aspects of his personality are his practicality and his enthusiasm, qualities echoed in two words that recur in his speech: 'fortunate' and 'fascinating'. For instance, he holds himself 'fortunate' in the twists of his personal history which have led him to make 'fascinating' investigations.

He was born in Skipton in Yorkshire, went to school in Keighley and to Leeds University, taking a First in Physics with Electrical Engineering. He proceeded at once to his Ph.D., achieving it at the exceptionally early age of twenty-two, with studies in the magnetic properties of crystalline substances—a subject on which he has never worked since, for the unexpected began to happen at once. His first job was at the Building Research Station of the Department of Scientific and Industrial Research, but he was not to do building research either. The time was summer 1939, and he was put into a group working on Civil Defence problems. Soon after war started, he was transferred to the Road Research Laboratory. There he was 'fortunate' in seeing many aspects of scientific warfare, but for the entire second half of the war he was engaged on problems of under water explosions, including some work on the now famous project that helped to make possible the blowing up of the Möhne Dam.

After the war he was invited to remain at the Road Research Laboratory to work on road traffic and safety research which was newly being undertaken at the Laboratory. Soon he was as deeply certain as the far-sighted Director, Dr. (now Sir William) Glanville, that their activity was in one of the biggest, not merely of our scientific and engineering, but of our social and economic problems, of the peace. In what was a completely new field for him, George Charlesworth was placed at the head of a group, later to become the Traffic and Economics section, which was concerned with investigations including the design of the Zebra pedestrian crossing, the use of electronic computers in traffic problems, traffic surveys, the design of road layout and economic studies of road traffic. He stresses the value of team work in this research and how 'fortunate' he was in the first-class team under him.

Dr. Charlesworth admits that he was surprised to be invited to come to the Ministry of Transport for two years in the first place, as Head of the new London Traffic Management Unit, but there was no difficulty about deciding. The opportunity of applying scientific method to a whole city's traffic drew him at once. In any case, it is a personal belief of his that a fair number of scientists should go over to the field of management. While the scientist must measure, and submit to the discipline of observation, his work must be modified by things that cannot be measured. Who can evaluate leisure or calculate suffering? Yet observation of human behaviour must be the basis of decision to recruit the public to this or that course of action.

Dr. Charlesworth has so far been setting up two parts of the new unit. The first of these is the Traffic Engineering Section, and here he has experienced some difficulty, for though he had a small nucleus of staff to draw on, additional personnel with actual traffic engineering experience was hard to find. Once again, however, he finds himself 'fortunate' in his team.

The second part of the unit is the scientific side, to carry out operational research and collect background data. Dr. Charlesworth's enthusiasm is to the fore again with the prospect of gathering information of the situation as a whole, so that solutions can be seen in proper perspective instead of piecemeal.

Inevitably, much of the unit's work meanwhile will be the application of short-term traffic engineering techniques, in co-operation with local authorities, to get the best out of existing facilities—one-way streets, kerb adjustment, better parking, signposting, lighting, delay investigation, parking meters, and so on. Dr. Charlesworth already envisages many tasks of one kind or another with which the unit will be dealing.

High ranking traffic engineers seem, pre-eminently, people who take work home, mostly their copious writings, but Dr. Charlesworth evidences no sense of hardship in this. He has never had any definite hobbies, because too many things have interested him. His reading too is catholic (thrillers to philosophy) and he enjoys Beethoven or 'Fats' Waller 'in the right setting'. Sport has always interested him; he played rugger and cricket for his University and he enjoys helping his wife, 'the expert', in their garden. Perhaps there is a hint

(Concluded on page 495)

Focus on
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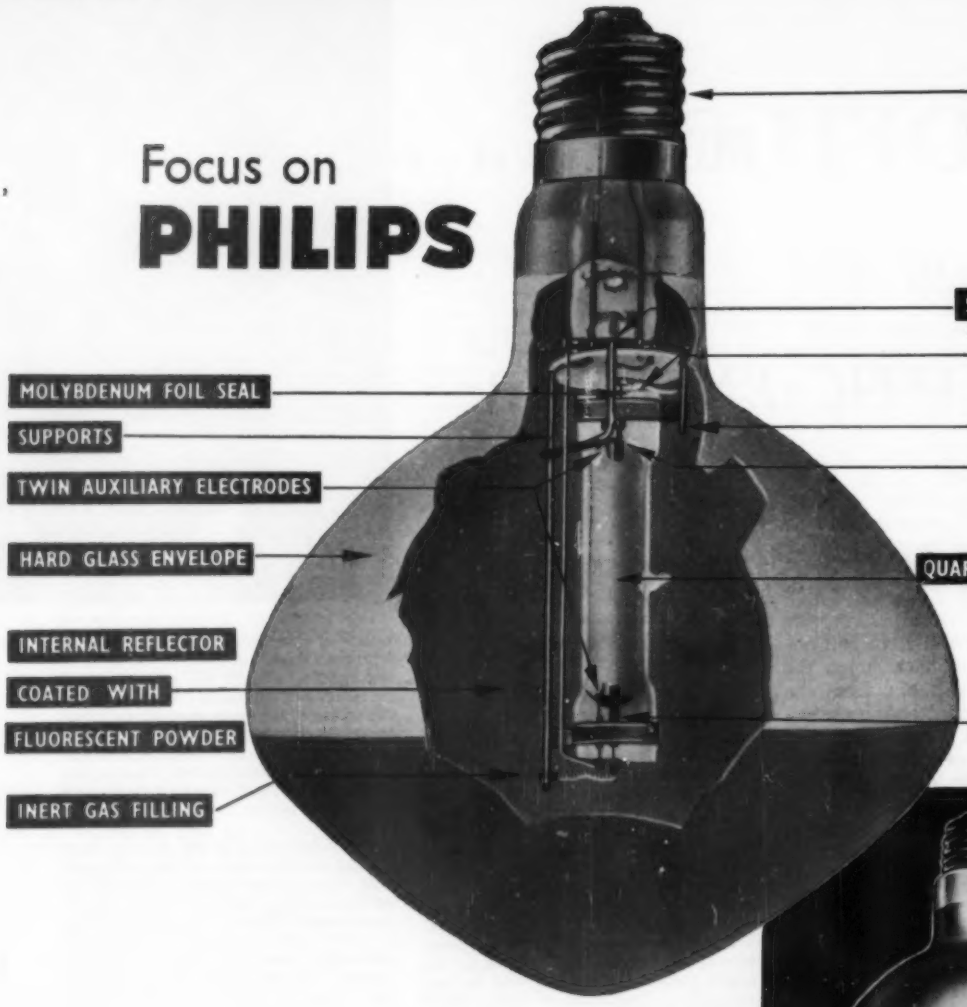

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MIDDLETON LANCASHIRE

by J. T. Grundy and G. Mawson

Fig. 1. Middleton town centre.

MIDDLETON, Lancashire, the heavily trafficked town between Manchester and Rochdale, lying on one of the main arteries into Yorkshire, is typical of many Lancashire towns. Its people are tough, resilient, frank and yet friendly. 'Courageous in adversity' is the town's motto. Dependence on the cotton industry is not so great as it was in the past, and the prosperity engendered by a mixture of general engineering work, woodwork and a variety of other manufactures, has enabled the town to reinforce its progressive policy in administration and public works.

Middleton is a growing town, considerable land being utilized for the re-housing of the overspill population of Manchester. In April, 1959, the authors presented a paper to the Association of Public Lighting Engineers (Lancashire and Yorkshire Section) at Barrow-in-Furness on 'The Planning of Street Lighting with particular reference to Lancashire'.[1] The paper dealt in detail with the Lancashire County Development Plan. Insofar as Middleton is concerned, it is estimated that the population will have increased by 27,000 persons by 1971, due to the Manchester overspill influx alone. This increase will be housed mainly in the Bowlee district, west of the town. Housing development at Hollins and Alkrington Garden Village caters for Middleton's own growing population, while a separate area is ear-marked for industrial development. The Town Centre itself is being re-shaped to meet the needs of the present day and the foreseeable future. Traffic flow has been studied and the new road arrangements are designed to cope adequately with the various types of traffic, while the shopping centre will provide amenities for shopping in comfort.

Fig. 2. New housing estate with Group B fluorescent lighting (Note columns at back of pavement and lantern tilted 10°).

With all these developments in mind, during 1957 and 1958, the important problem of choosing suitable street lighting equipment to match the requirements of the present and future was tackled by the Council's Street Lighting Committee, and the Borough Surveyor, Mr. G. Syddall, A.M.I.Mun.E., A.R.I.B.A.

They attended exhibitions of public street lighting equipment and looked at work done by other local authorities. Finally, the 'Siemens-Ediswan' Kuwait Unitary Street Lighting System was chosen as the most appropriate. In the Town Centre 500 watt tungsten lamp lanterns, installed in the '30's on steel traction columns, fed by overhead cables, were replaced by single arm Kuwait lanterns housing 4-5 ft. 80 watt fluorescent lamps and twin arm lanterns with 8 lamps. Concrete columns, supplied by Stanton Ironworks Limited, replaced the steel traction columns and a new underground electrical supply service was provided where necessary by the North Western Electricity Board.

The improvement in daylight appearance to the Town Centre (Fig. 1) by this operation alone was considerable. The night time effect is highly satisfactory: adequate light for the motorist and pedestrian, without glare or colour distortion. Although between midnight and 5 a.m. two of the four lamps in each lantern are switched off, the light output during this period remains greater than that given by the lanterns in the old installation.

The same foresight and patient application was applied to the lighting of the new housing estates. Soundly constructed fluorescent lanterns of the same basic system as those in the Town Centre were found to be a suitable and economical proposition for certain areas compared with alternative types available. Length of life, maintenance and running costs, appearance and colour rendering were in favour of the Crawley lantern, the twin lamp 2 ft. 40 watt version in the Kuwait range. Householders on the Alkrington, Hollins and other development sites can now enjoy an advanced standard of minor road lighting that compares with any in the country (Fig. 2).

Within recent years, the roads leading from Manchester to Middleton were provided with the best type of sodium lantern obtainable. This form of lighting has become acknowledged as most appropriate for main traffic routes away from town centres. It provides good visibility for road users at moderate cost. In 1959 a great step forward was announced in the design and manufacture of the sodium lamp. The new 36 in. linear lamp provided a degree of light output never before achieved, and it was an obvious tool to be considered by an authority keen to provide the best road illumination on two roads which were under consideration for improvement: the main Rochdale Road and Oldham Road.

The 'Siemens-Ediswan' Osprey Lantern designed for use with the new sodium lamp is the same in external appearance as the 3 ft. fluorescent lantern in the Kuwait range, known as

TEC318 *for further information*

Mr Saxon adds to his fleet

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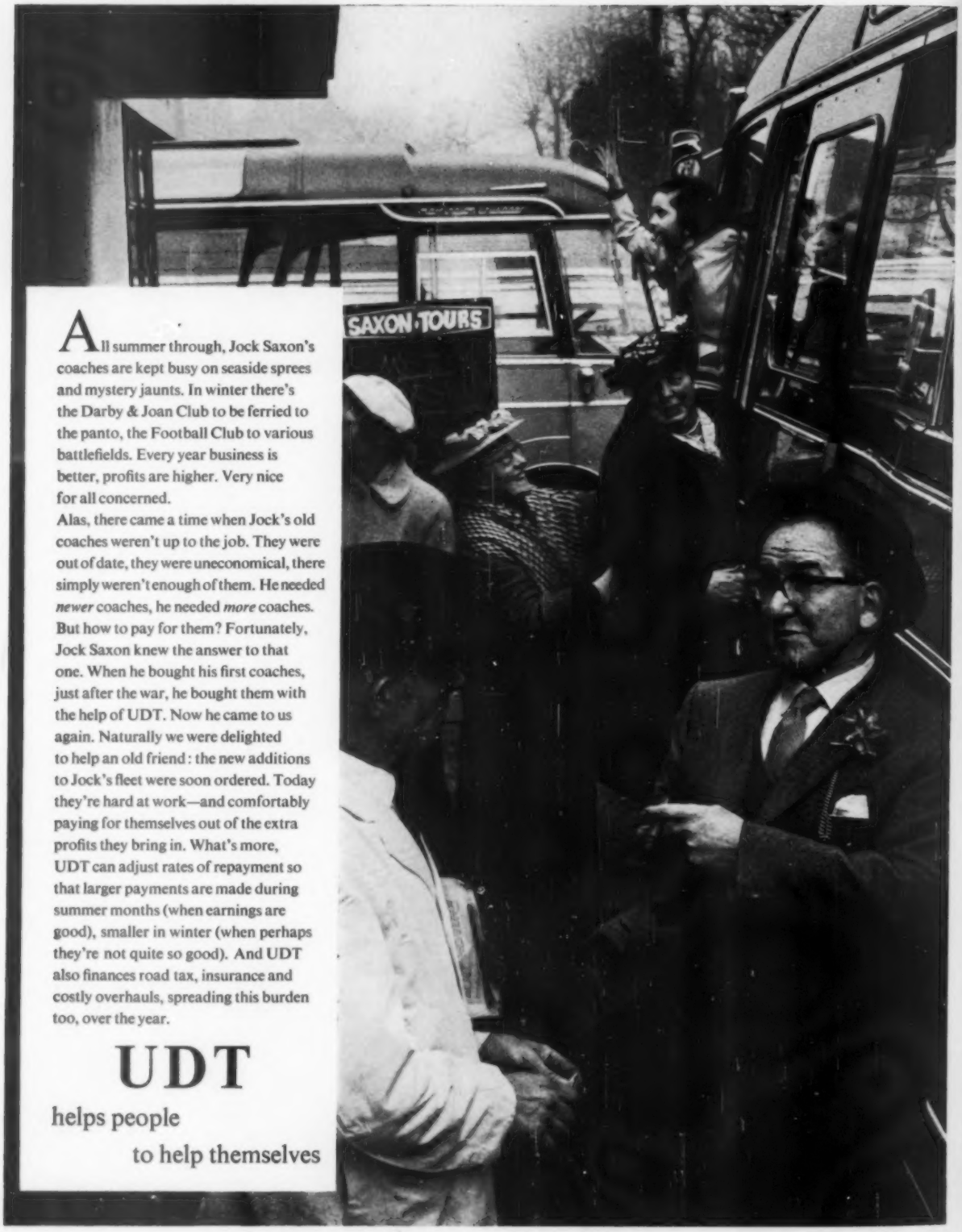

All summer through, Jock Saxon's coaches are kept busy on seaside sprees and mystery jaunts. In winter there's the Darby & Joan Club to be ferried to the panto, the Football Club to various battlefields. Every year business is better, profits are higher. Very nice for all concerned.

Alas, there came a time when Jock's old coaches weren't up to the job. They were out of date, they were uneconomical, there simply weren't enough of them. He needed *newer* coaches, he needed *more* coaches. But how to pay for them? Fortunately, Jock Saxon knew the answer to that one. When he bought his first coaches, just after the war, he bought them with the help of UDT. Now he came to us again. Naturally we were delighted to help an old friend: the new additions to Jock's fleet were soon ordered. Today they're hard at work—and comfortably paying for themselves out of the extra profits they bring in. What's more, UDT can adjust rates of repayment so that larger payments are made during summer months (when earnings are good), smaller in winter (when perhaps they're not quite so good). And UDT also finances road tax, insurance and costly overhauls, spreading this burden too, over the year.

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the Carpenter lantern, and has an interchangeable optical system.

On Rochdale Road, the existing lighting consisted of 140 watt sodium lanterns mounted on the old traction columns, and a fresh up-to-date layout was essential. Therefore, this installation was completely removed, and on the road the Osprey lantern is mounted at 30 ft. on Concrete Utilities Limited 'Highway' columns, the spacing varying from 115 ft. to 150 ft. depending on the road width of 55 ft. down to 35 ft.

In the nineteen-thirties, steel columns were installed on Oldham Road with 250 watt mercury vapour discharge lamp lanterns, the lanterns being suspended from brackets at a mounting height of 25 ft. to the centre of the light source (Fig. 3). These columns, being in good condition, were simply adapted for use with the Osprey lantern by removing the 250 watt mercury vapour lanterns, the brackets and stays, and socketing the Osprey lanterns to the top of the column shafts. By this means a very agreeable combination was achieved, and the mounting height was increased from 25 ft. to 30 ft. at no extra cost. The spacing is 120 ft. to 136 ft. on the 30 ft. to 35 ft. carriageway through a solidly built-up area. From the point of view of road illumination, linear sodium lamps give many more lumens per 100 ft. linear than the original 250 watt mercury vapour installation but use less electricity, namely 200 watts, and a completely converted unit is shown (Fig. 4).

Middleton thus has a unique application of the Kuwait Unitary System, in which the same style of lantern is not only used for fluorescent class 'A' and class 'B' road lighting, in the Town Centre and housing estates, but is also used with linear sodium lamps for superior 'A' road lighting on outer roads.

These traffic routes now have a surface of rolled asphalt, and with the 36 in. linear sodium lamps, the average illumination through life below the horizontal per 100 ft. linear is between 8,200 and 10,600 lumens according to the spacing of 150 ft. to 115 ft. This can be compared with that laid down in the existing B.S. Code of Practice CP:1004 of 2,600-7,000 lumens per 100 ft. linear.

Fig. 3. Oldham road existing steel pole and mercury vapour lantern in process of conversion to linear sodium lighting.

Fig. 4. Oldham road complete steel pole conversion from mercury vapour to linear sodium street lighting at 30' mounting height.

The new high skid resistant road surfaces coming into use at the present day, as the result of highly commendable work by the Road Research Laboratory, are presenting problems to the lighting engineer due to their low reflectivity as compared with the earlier surfaces. Middleton proved no exception. In fact, the Road Research Laboratory have in several papers referred to this matter. The Osprey lanterns had their original field trials in Coventry in July 1959 under the auspices of Mr. Granville Berry, M.I.C.E., M.I.Mun.E., Past President of the Association of Public Lighting Engineers, and a peak beam candle power of 4,000 at 74° was produced by the reflector optical system with a directional intensity ratio of 3.5, 14 per cent light above the horizontal and a light output ratio of 80 per cent. When these lanterns were installed on the Middleton Roads the installation appeared unsatisfactory from a road brightness point of view, and with the generous co-operation of Mr. Syddall and his staff the 'Siemens-Ediswan' lighting engineers experimented with various optical arrays. Using reflector systems, it is a comparatively simple matter to make wide adjustments in street lighting lanterns, and a final optical system with a peak candle power of 4,635 at 75° was produced having a directional intensity ratio of 2.4, 16 per cent light above the horizontal and a light output of 79 per cent. This particular arrangement gives highly satisfactory results on the Middleton road surfaces, and it would appear reasonable in large future installations elsewhere for the lighting engineer to have to produce an optical system to suit the particular road surface involved as an integral part of the lighting installation. Furthermore, where the road width exceeds 40 ft., as is happening today, it is proving necessary to project the lanterns out from the poles for greater utilization, and accordingly side entry Osprey lanterns have been developed as distinct from the post top mounting type. This had the added advantage that it is thus possible to set the poles back, say, 3 ft. from the curb where adequate footpath width is available, as distinct from the present practice of 18 in. back.

Where columns are mounted only 18 in. back, this had the tendency to cause motorists to travel further out from the curb than is absolutely necessary.

The attitude shown by the authority of this modest town of Middleton in the adoption for its various needs of the most advanced forms of road lighting produced by our scientists and engineers is surely worthy of commendation and an example to others.

REFERENCE

[1] GRUNDY, J. T. and MAWSON, G. 'Planning Street Lighting,' International Civil Engineer and Contractor, March-April, 1960.

Profile

concluded from page 491

of why Dr. Charlesworth finds himself so 'fortunate' in his teams in his readiness to leave his three teen-age children to decide for themselves what to do to make them happy, as he himself was left free by his schoolmaster father.

Despite much travel on the job, attending PIARC and OTA conferences, and having been sent abroad by the Road Research Laboratory, fact-finding or advising foreign governments on traffic and safety problems, Dr. Charlesworth finds time for holidays, preferably in his beloved Yorkshire; and perhaps not the least of things in which he is 'fortunate' is that his wife, herself from the East Riding, shares his love of their county.

R.L.

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INDUSTRIAL NEWS AND INFORMATION . . .

THE Metropolitan Construction Co. is offering a useful service to road engineers and anyone concerned with the repair and maintenance of concrete roads. This service, known as the Mettexture Process, enables permanent repairs to be made to concrete surfaces with only very thin new toppings.

Very briefly, the Mettexture unit, which is operated mechanically, enables about ¼ in. to be taken off the original surface, exposing the aggregate and its matrix in a sharp, uniform, regular plane. Most of the laitence is removed at the same time and the whole process completed with one pass of the machine. Further passes of the unit will remove additional amounts, permitting carefully controlled preparation of the concrete surface. High spots and ridges can be levelled.

This process, originally developed successfully to produce an anti-skid surface on polished concrete roads, makes possible the marrying of toppings no more than ¾ in. thick to the worn surface and a remarkable degree of adhesion is obtained. It will be realized of course that there must be a differential shrinkage in the new wet topping superimposed on an already dried and cured base. Certain elementary precautions, which are good practice in any case, are suggested to overcome this. Experience shows that, providing reasonable care is taken, new toppings 1 in. thick can be laid satisfactorily and a number of patches on the London-Birmingham Motorway are still in perfectly sound condition after 12 months under very severe conditions.

T.E.C. 125 for further details

New Compressor

A new rotary compressor (260-RO-2) with a capacity of 260 c.fm. at 100 p.s.i. has been recently introduced by the Consolidated Pneumatic Tool Co., Ltd., of London. The principle used is the 'Power Vane'. An eccentric rotor, equipped with sliding vanes, compresses the air in a cylindrical chamber, into which a very fine spray of oil is pumped to lubricate and seal the clearances and cool the air heated by the compression. The 260-RO-2 is a two-stage, in-line machine with power supplied by a six-cylinder Leyland diesel engine through a safety friction drive.

This diesel injection engine, known as the V.E.375, is of the water-cooled overhead valve type with a stroke of 4.75 in. and a bore of 4.1 in. The compression ratio is 16 to 1. The crank case and cylinders are of integral cast-iron construction with dry, cast-iron liners, while the balanced steel alloy crankshaft has nitrided surfaces. The governor is a Swiss all-speed mechanical type fitted with the injection pump and driven from the timing gears by a positive drive. Alignment of this engine and the casing of the first stage compression chamber is ensured by a tandem piece supporting the casing and bolted to the engine flywheel housing.

T.E.C. 126 for further details

in the JANUARY issue

TRAFFIC ENGINEERING & CONTROL

will review the

Public Works Exhibition

Sign Making Simplified

All types of signs incorporating the latest reflective safety features can now be produced by local authorities and small sign manufacturers without skilled labour. This remarkable step, designed to meet emergency sign making needs is possible with the introduction of a new vacuum applicator, which is virtually a 'do it yourself' sign kit for Scotchlite brand reflective sheeting and Scotchcal brand film. An unskilled operator can produce fully reflective signs with the same durability and safety features of major contract signs now erected on roads in this country. Examples which readily spring to mind of the type of signs often needed quickly are diversion signs, flood warnings, police notices, survey warnings and instructions, and road obstruction warnings.

This machine, which is shown below, has a capacity of nine signs per hour and can produce any sign up to 26 in. by 30 in. Unskilled labour can be employed and only one man is needed to operate the complete process.

T.E.C. 127 for further details

New Graders

New, extra heavy graders are to be made at Grantham by Aveling-Barford Ltd. and the heaviest of these machines, the Super 500, was on display at Olympia during the Public Works Exhibition. This machine weighs 30,000 lb. with cab and scarifier, and is powered by either a Leyland 163 b.h.p. or Rolls Royce 170 b.h.p. diesel engine. It has six-wheel drive through a torque converter with six forward and two reverse speeds. Precise steering through all wheels makes possible the exact positioning of the blade. Two features new to this machine, which is a development of the 99H grader built by the same company to an American design, are hydraulic control of the blade pitch and a device by which angular rotation of the steering tiller controls the flow of oil to the front steering ram. This latter innovation gives the operator fine control when travelling at high speeds and also maintains the full hydraulic pressure required for site work.

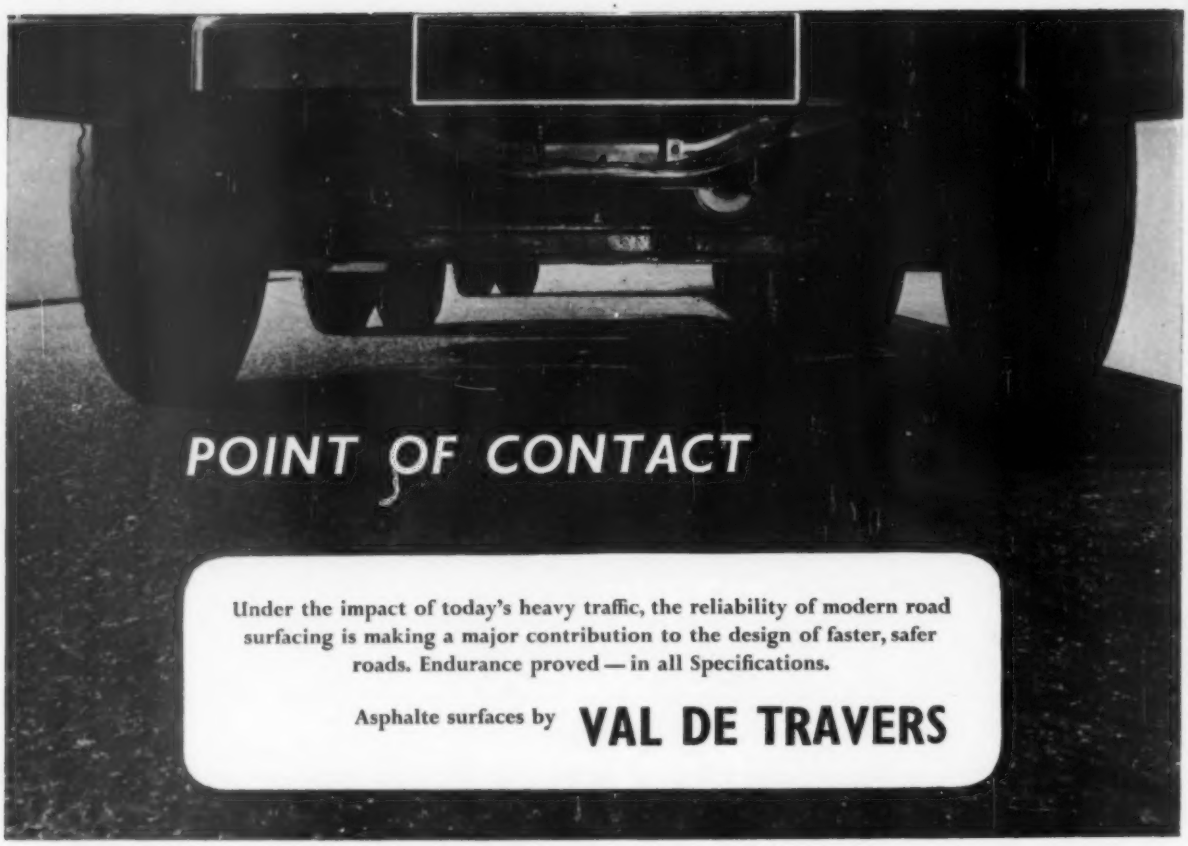
T.E.C. 128 for further details

William Bunce & Son

At the Public Works Exhibition in November, William Bunce & Son showed nine items of equipment. Amongst them was an example of the Bunce Grit Economiser, a machine which sweeps and spreads frost grit back into the path of traffic, when heavy trafficking of roads has dispersed it to the roadside. A simple rotating brush is attached to any tractor fitted with a power take-off and hydraulic lift, and the grit can be re-used as often as the dangerous conditions require.

Snow blowers, a snow plough and gritting machines were also on display at this stand.

T.E.C. 129 for further details



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Asphalte surfaces by **VAL DE TRAVERS**

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Latest short-term kerb parking control

Arrows clearly indicate each parking space and coin-slot

Broad red flags—clear visibility—rapid mobile or foot-patrol check

One clock—one weekly winding—one coinbox serves both spaces

Use one meter on one post to control two cars—posts 40 ft. apart

Really secure coinbox and on-site collection system

Suitable for all climatic conditions

All mechanisms interchangeable—on-site replacement without tools

Vibrations will not affect timing

Instant operation on insertion of coin—last coin in view

Neat sturdily built mechanism—pressure die-cast housing

Greater turnover at kerb and greater earnings towards off-street parking programmes

Do not invite excess-time parking—it defeats metered control. Install the Duopark Twin cancelling type meter as used in many countries.

Phone Hol 2913

S. Markman of London Ltd.

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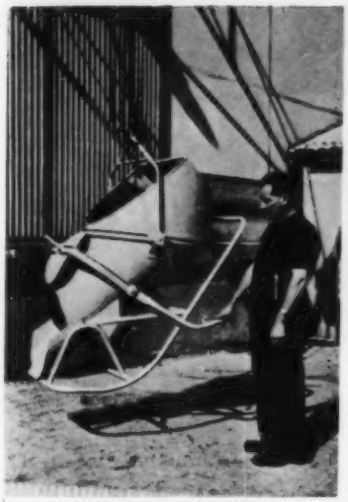
Cables Ezepark



A Record, free-flow skip.

The New Cut-off Amberline Lantern

The new cut-off 'Amberline' lantern made by A.E.I. Lamp and Lighting Co. Ltd. is designed to comply with British Standard Code of Practice 1004 Part I 1952 for Group 'A' roads where a fully cut-off distribution is required. The lantern consists of an end casting and a 'Perspex' enclosure which houses specular magnesium aluminium alloy reflectors for accurate light control. The end casting, aluminium alloy (LM6), has a removable metal cover to give easy access for re-lamping and normal maintenance. The cover is secured in place by a stainless steel coin slot screw and a safety chain is fitted to allow the cover to hang freely when it is removed for maintenance. The casting carries the lamp support channel assembly which includes a terminal block, cable clamp, earth screw and thermal relay. At the roadway end of the support channel a retractable bi-pin lamp holder (A 17456) is fitted and a metal stirrup is provided to act as a guide during re-lamping operations. At the lantern access end a push-on, bi-pin holder (A 18280) is fitted on short flexible leads to allow slight freedom of movement. The 'Perspex' enclosure comprises a 970 grey 'Perspex' canopy cemented to a flat clear 'Perspex' Panel. The specular magnesium aluminium alloy reflectors are fitted within the canopy and the entire 'Perspex' assembly is securely held in position by four 'J' bolts passing through 'Perspex' blocks which are firmly bonded to the walls of the enclosure. All 'Perspex' to metal, and metal to metal, joints are rendered weatherproof by the use of Neoprene gaskets which are used for sealing the 'Perspex' envelope to the end casting and also between the access cover and the main body casting. The top of the casting includes the side entry facility and the outreach bracket is secured by 'Allen' screws located under the canopy for protection and appearance.

T.E.C. 130 for further details

Concrete Skips

The Cornelly Equipment Co. Ltd., have introduced a new range of Record free-flow concrete skips in roll-over, side discharge or bottom discharge models. The feature of this range of skips is the circular design which gives increased strength at approximately half the weight, enabling larger pay loads to be carried when using a tower crane. The circular shape also gives improved flow as there are no corners where concrete can stick and build up. A large range of sizes are available from 1¾ cu. ft. to 4 cu. yd. It is claimed that with three designs and 39 sizes, suitable skips can be supplied to cope with any site conditions.

T.E.C. 131 for further details

Units for Road Marking

A new method of road marking has been developed and patented by Wimpey Asphalt and Causeway Reinforcement Limited, a member of the Amber Group of Companies. The method makes use of white line units which are a combination of Causeway's triangular steel reinforcement, mastic asphalt and a white topping of verynyl strip secured to the armour frame with a bonding material. The verynyl surface is exceptionally white, self-cleaning, anti-skid, and immune from attack by oil, grease, petrol or diesel fuel. The units are sunk level with the road, avoiding tyre noise and ensuring maximum safety. Each unit is 3 ft. long, 1 in. deep, and of the standard 4 in. width.

As each unit is complete in itself, no skilled labour, unusual care in handling, or special plant is needed. The verynyl surface of the units are claimed to last five years, and is then removable at a small cost. The ex-works cost of 12s., together with the ease with which they can be laid, lead to an initial cost which is claimed to be only 40 per cent of that of white mastic.

T.E.C. 132 for further details

Pigeon Hole Parking

A new company has been formed in this country to handle the construction of an American system of parking in multi-storey garages. It is called Pigeon Hole Parking (U.K.) Ltd. The first projected garage to be built in this country and use this system is to be at Leeds, where the city centre is to be provided with space for 213 cars.

The operation of parking cars by this method is based on a moving elevator, which runs on rails between two rows of multi-storey reception stalls. These stalls can be built to range from three storeys upwards. An extending dolly travels out from either side of this tower, raises the car and places it on the central tower, and raises the car on to the elevator platform. The only attendant, who stands on the left of the lift platform, travels in the elevator while the dolly deposits the vehicle in the space he has chosen.

T.E.C. 133 for further details

New Two-way Dumper

Thwaites Engineering Co., Ltd., have recently introduced an addition to their range of hydraulically controlled dumpers. This is a two-way discharge dumper, providing hydraulically controlled discharge of 27 cu. ft. of material to either side of the machine whilst travelling under load, an operation controlled by a single lever movement mounted on the steering column. Operation of the skip is by twin hydraulic rams, the driver being able to change direction of discharge as required without transfer of nuts, bolts or pins, and without leaving his seat. Patents have been applied for. Discharge is 1 ft. 3 in. above ground level with the lower edge of the skip in sight of the driver on the near side. Accurate control of rate of discharge, to avoid 'heaping', can be obtained, or complete discharge can be effected in seven seconds. Loading height of the skip is 48 in.

T.E.C. 134 for further details

A Thwaites two-way discharge dumper in action

TEC322 *for further information*

How smoothly and evenly the traffic flows . .

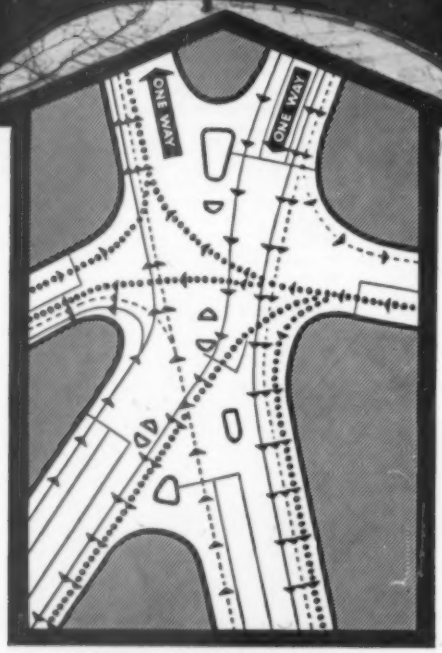


Diagram indicates flow of traffic controlled by Autoflex at Swiss Cottage, Hampstead, London.

when controlled by

AUTOFLEX

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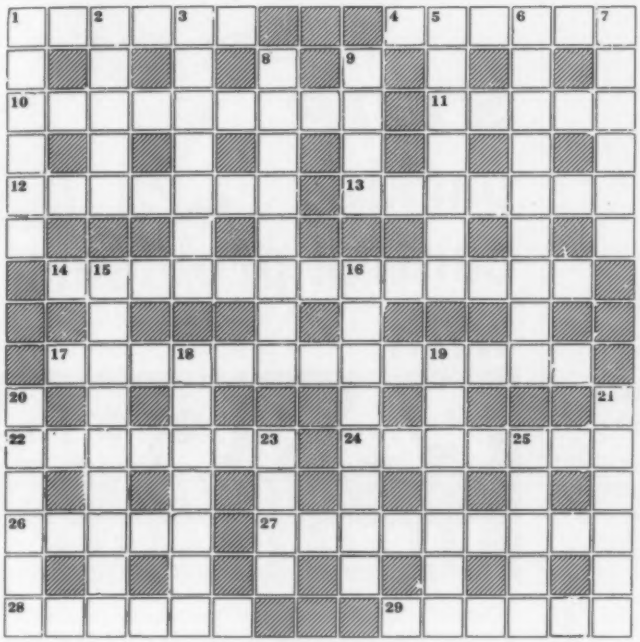
TRAFFIC ENGINEERING CROSSWORD NO. 6 by YEO

AMONG the clues and solutions will be found traffic engineering terms defined in the VOCABULARY OF TRAFFIC ENGINEERING TERMS published for *Traffic Engineering & Control* by Printerhall Ltd., and a copy of which is sent free to all subscribers to this journal. Copies are also available at 2s. 6d., post free, from the Circulation Manager, Traffic Engineering & Control, 34/40 Ludgate Hill, London, E.C.4.



SOLUTION TO CROSSWORD NO. 5

M	A	R	K	I	N	G	S	■	T	I	P	T	O	P
E	■	E	■	N	Y	■	■	L	■	O	■	R	■	■
D	R	E	S	S	E	R	S	■	D	E	G	R	E	E
I	■	F	■	P	■	O	■	■	U	■	E	■	C	■
A	B	E	L	E	■	C	R	O	S	S	F	A	L	L
N	■	R	■	C	■	O	■	U	■	■	D	■	U	■
■	■	■	■	T	I	M	E	T	O	B	E	O	L	D
V	■	A	■	O	■	P	■	Q	■	R	■	R	■	E
O	F	C	U	R	V	A	T	U	R	E	■	■	■	■
T	■	C	■	■	■	S	■	A	■	A	■	O	■	L
E	Q	U	A	L	I	S	E	R	■	D	R	U	P	E
L	■	R	■	A	■	■	■	T	■	L	■	T	■	S
E	X	A	C	T	S	■	P	E	R	I	P	L	U	S
S	■	T	■	E	■	■	■	R	■	N	■	E	■	O
S	P	E	A	R	S	■	A	S	S	E	N	T	O	R

Across

1 & 4. A Professor on Our Board. (6, 6)
10. Twice round love's range in pictures. (9)
11. Lil. (5)
12. 'Ah why
Should —— —— labour be ?' (Tennyson). (4, 3)
13. Cuts and joins four ways. (7)
14. Future international roadway ? (7, 6)
17. Not the extent of the motorist's yarn. (7, 6)
22. Work to the bone total Didelphys. (7)
24. An outline of a vertical section of the ground or (7)
26. Musical disturbed symbol. (5)
27. Te or Se are. (9)
28 & 29. As far as we can understand the vocabulary you had better go counter clockwise. (6, 6)

Down

1. Part of a leg. (6)
2. Diplomatic operations leading to the summit fool us. (5)
3. Link together. (7)
5. Middle Eastern Scot. (7)
6. Two compass points on the trail of old age. (9)
7. Sin with nothing but the Royal Society. (6)
8. Pen Pleas. (Anag.) (8)
9. Venemous as an afterthought. (4)
15. Blood stops even though Latin love and passion get embroiled with a small saint. (9)
16. Transports transports invisibly. (8)
18. It's in a hood on a signal light. (7)
19. Edible dunderpates. (7)
20. Reform reform. (6)
21. Sold -a pup ? (6)
23. Operatic dual motorway. (4)
25. Images have nothing between instinctive forces and the French. (5)

NEW PUBLICATION

Nationalized Industry and Public Ownership by William A. Robson, Allen & Unwin, 50s.

WRITING with authority, as Professor of Public Administration at the London School of Economics and Political Science, Dr. W. A. Robson has with great thoroughness recorded the structure, administration and performance of industries in public ownership and added his own commentary upon their many problems. He is wedded to the public corporation as the best type of public administration for the nationalized industries and services which operate on a commercial basis, but does not minimize the difficulties which confront them, particularly in the realm of their relations with government and Parliament. It has frequently been suggested that greater progress would be made with the creation of a modern road system more in keeping with present day needs, if responsibility for their construction were transferred from the central and local government to a public roads board. Those who favour this will find no encouragement in Dr. Robson's critical analysis of existing corporations, as they will observe the many conflicts that arise between Minister and Corporation and, in particular, the British Transport Commission's experience in this regard. There is, therefore, no reason to believe that the present long delay between planning of road projects and their execution would be in any way reduced. Dr. Robson has written an extremely valuable book, which is certain to remain standard for a long time to come, covering as it does the first decade of the post-war nationalized industries. All who are concerned with national or local government, or with the nationalized industries, would benefit by studying his critical examination of the administrative process.

TEC323 *for further information*

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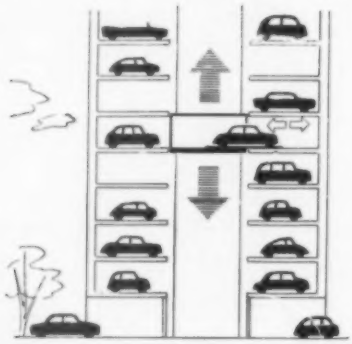

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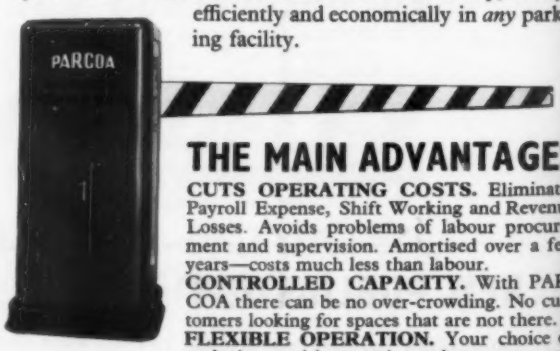
PARCOA automatic parking systems provide the complete mechanical answer to trouble-free control. This well-proven system can be relied on to handle traffic smoothly, safely, efficiently and economically in *any* parking facility.



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